THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

VOL. IX.—No. 205.

THE PARIS ELECTRICAL EXHIBITION.

ON Wednesday, the 10th inst., the opening of the Paris Electrical Exhibition was practically inaugurated by the visit of M. Grévy, the President of the French Republic. Although the Exhibition was by no means ready, wonderful progress had been made towards getting matters into a presentable shape during the early morning of the day of the President's visit, so that a very fair and orderly array of apparatus was to be seen in the various sections of the building. In many cases, it is true, almost bare tables were all that were presented to view, and in this respect the British Department was not the least conspicuous, although the very select display of exhibits made by many manufacturers went far to hide this defect.

Immediately on entering the building, amidst the martial strains of a fine military band, the President proceeded through the various sections of the British Department, being conducted through the latter under the leadership of Lord Crawford and Balcarres the Chief British Commissioner; the Austrian, German, and other Departments, were next inspected, and the President then left the building, having examined the principal objects to which his attention had been drawn. In the British Department the most conspicuous stand is undoubtedly that of the Postal Telegraph Department, and here a large collection of ancient and modern apparatus is shown. The earliest workable telegraph exhibited (which has been lent by Mr. Latimer Clark) is that of Ronald's, which dates from 1816. Although not a practical apparatus, it had the great merit of being more than merely theoretical, as messages were actually and successfully transmitted by its means, and as a scientific curiosity it is certainly one of the most interesting exhibits in the collection. From 1816 to 1837 is a considerable gap, but from the latter year the electric telegraph in England as a successful enterprise practically dates. In 1837 the first underground telegraph was laid between Euston and Camden, the wires being insulated by being imbedded in scantlings of oak; the instrument worked through this line of wires had five needles, and was known as the "Hatchment" telegraph. In 1838 the five needles were reduced to four, and in 1842 the number was still further diminished to two. This latter instrument for many years did excellent work and was largely used, and although it has now for some years been suspended, it is still remembered with affection by many clerks who used to work it, as its powers of getting off messages were very considerable—more, indeed, than might be imagined. A remarkable specimen of the instrument in an enormous Gothic case is amongst the exhibits. This instrument was made for use in the Houses of Parliament, and its case was, it is said, designed specially to harmonise with the architecture of the Westminster buildings. A double-needle instrument, dated 1852, and designed by Messrs. Edwin and Latimer Clark, is one of the earliest forms of a thoroughly practical train-signalling instrument, indeed, its principle is still largely used at the present day. The single needle-apparatus, which dates from 1846, is still very largely employed in England, and its form remains, generally speaking, as it was originally. The pattern at present employed by the Post Office dates from 1869. In the Bain-needle instrument, devised in 1843, the signals are produced by the movements of two distinct needles, the one moving to the right and the other to the left. The gold-leaf apparatus of Highton, although not adapted for rough work, was used to some slight extent, and it was proposed a few years ago to employ it for working on submarine cables, but the project was never successfully floated. Compared with the easy working apparatus of the present day, the magneto-electric needle instrument of Henley, dated 1848, is a very heavy-looking piece of work, yet its general design is by no means bad for the date at which it was employed, and in the hands of efficient clerks it did good service, although its manipulation must have been extremely fatiguing. The alphabetical telegraph apparatus of Wheatstone, of the present day and of the year 1840, are certainly remarkable contrasts, the latter being as clumsy a piece of telegraph machinery as can well be conceived, the former a perfect specimen of mechanical skill and design, yet one which seems doomed to be superseded by its simpler rival the telephone.

The relics of a bygone age, in the shape of transmitting keys, relays, &c., are interesting to those who wish to know the progress that has been made both in electrical and mechanical skill since the telegraph became a practical reality. Specimens of wire joints, old railway signalling apparatus (the latter peculiarly interesting, as it shows that the use of the telegraph to train signalling was as early as its use for message transmission), old lightning protectors, old insulators, and a specimen of the first cable laid across the Channel, completes the list.

In modern apparatus, Great Britain is certainly not behind the other nations, and although the whole of the instruments and material in use at the present day are not represented, yet a very good show is made. In fast-speed apparatus Great Britain is undoubtedly well ahead of other countries. The fast repeater and fast duplex repeater-boards are fine specimens of workmanship, design, and arrangement, and indicate well the perfection to which this kind of apparatus may be brought; many of the boards are in daily use in the Postal Telegraph Service, and enable long circuits in our

peculiar climate to be worked throughout at their utmost speed. A very great deal of the success obtained in high-speed working is due to the form of relay used, and great credit is due to the designers of the form at present employed in the Post Office. An Umschalter switch for intercommunication between various lines, constructed in the postal workshops, is a fine specimen of good workmanship. The other apparatus exhibited are as follows: double current sounder set; testing tangent galvanometer, with standard cell; numbering machine for stamping messages; modern form of train-signalling apparatus (Preece's); apparatus connected with pneumatic tubes, together with specimens of the letter-carriers, &c.; and an electrical water level indicator.

Next to attract observation after the Post Office apparatus is the display of Messrs. Siemens Bros. & Co. (of England), who show a pyramid of coiled cable on which is mounted a submarine telegraph buoy; the latter is crowned by a beacon, the whole forming a most appropriate centre-piece to the remaining portion of the smaller exhibits. This firm displays, in addition to the foregoing, a large number of dynamo machines and lamps, an electrical railway, &c., whilst surrounding the space allotted to the above-mentioned buoy will be found electric conductors, electrical instruments, and apparatus of various kinds.

We must not omit to mention one noteworthy exhibit which occupies the centre of the nave, and which consists of a tower supporting a lighthouse, and surrounded by an ornamental piece of water on which floats an electrically propelled boat, named the *Telephone*. The lighthouse is to be illuminated by the De Meriten's system. There will also be much interest attaching to the Tissandier balloon, propelled by a dynamo-electric machine. An experiment with this aerial machine was made during M. Grévy's visit.

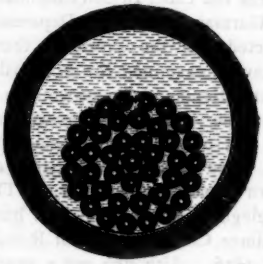
The exhibit of Messrs. Elliott Brothers, near to that of the British Postal Telegraph Department, is very extensive, and includes specimens of most of those instruments for testing and measuring for which this firm is so justly celebrated. To this exhibit we shall again refer. The India-Rubber and Gutta-Percha Company show a collection of specimen cables, &c., and a sample length of the Brooks' underground cable. The Telegraph Construction and Maintenance Company have a fine collection of submarine cables of types already in operation. We must, however, pause for the present in our course, but in conclusion would refer to what will probably prove to be the most important display of electric lights ever seen, and which will certainly be one of the most attractive displays in the whole exhibition. There may be seen the Brush, the Siemens, the Brockie, the Pilsen, and other arc lamps, the Joel-Werdermann, the Swan, the Edison, the Lane-Fox, and other incandescence systems, besides almost innumerable dynamo-machines to be used in generating power for illuminating the same.

To drive the generators, steam-engines by some of our most noted English firms, such as Messrs. P. Brotherhood, Robey & Co., Marshall & Co., Ransomes & Co., and Wallis & Stevens, will be largely employed.

BROOKS' UNDERGROUND TELEGRAPH SYSTEM.

LAST year Mr. David Brooks, of Philadelphia, made a proposition to the Postal Telegraph authorities that he should lay an experimental length of his underground telegraph system (*see* TELEGRAPHIC JOURNAL, Dec. 1, 1879) between Waterloo and Nine Elms on the London and South-Western Railway. The length laid was to be paid for on condition that it worked satisfactorily for a period of six months. Mr. Brooks also proposed to extend the system from Nine Elms to Clapham during the following year (1881) upon the same terms as those first proposed if the postal authorities thought fit to accept them. In the spring of the present year Mr. Brooks returned to England to carry out his second proposition, as the Post Office had accepted his offer, the preliminary experiment having proved quite satisfactory. The extension of the line from Nine Elms to Clapham has now been completed, and promises to prove as great a success as has the trial line.

The line completed last year consisted of 30 No. 18 copper conductors, each insulated with a jute serving, and then spun into a cable and drawn into a 1¼-inch iron pipe, the latter, as explained in the number of the JOURNAL before referred to, being filled with paraffin oil; the total length of this line was 7,000 feet. The extended line from Nine Elms up to Queen's Road, a distance of 5,800 feet, also consists of 30 wires similar in every respect to those first laid down. From Queen's Road to Clapham, a distance of 7,000 feet, the cable is



formed of 40 wires of a similar gauge, as regards the conductor, to those in the first-mentioned lengths, but with a slightly thinner jute serving, so that the whole 40 could be inclosed in a 1¼-inch pipe. In both cases the total outside diameter of the cable was about one inch.

Owing to a difficulty in making a proper termination to the cable at Waterloo, the ends of the wires were unavoidably exposed, to a considerable extent, to the weather, and consequently reliable tests could not be taken, more especially as it was necessary to employ a lead wire of 500 yards, insufficiently protected, to make the tests with. Sufficient knowledge of the condition of the cable was, however, obtained to justify its being considered in thorough working condition, and time has proved that this conclusion was completely correct.

During the present season the work of extending the system was commenced and carried on from the Clapham station, where better opportunities were afforded of making tests than could be obtained at Waterloo. The following are the results obtained from Nos. 1 to 10 inclusive of the 40-wire length between Clapham and Queen's Road, a distance of 7,000 feet :—

No. of Wire.	Insulation Resistance per Mile in Megohms.	Electrostatic Capacity per Mile in Microfarads.
1	3·06	·487
2	2·82	·475
3	2·71	·464
4	2·52	·475
5	2·75	·475
6	2·81	·487
7	2·95	·453
8	2·90	·475
9	3·00	·487
10	Not tested, being in use for working purposes.	

The remaining 30 wires of the 40-wire cable (which, as explained, only extended to Queen's Road) were joined to the 30-wire cable, which reached to Nine Elms, a total distance of 12,800 feet, and the tests taken gave the following figures :—

No. of Wire.	Insulation Resistance per Mile in Megohms.	Electrostatic Capacity per Mile in Microfarads
1	2·13	·446
2	2·09	·451
3	1·78	·451
4	2·06	·451
5	2·13	·446
6	2·20	·446
7	2·13	·451
8	2·06	·446
9	1·50	·451
10	2·00	·446
11	2·13	·451
12	2·06	·439
13	2·13	·451
14	2·20	·446
15	2·13	·446
16	2·13	·446
17	2·13	·458
18	2·13	·451
19	2·20	·451
20	2·06	·451
21	2·06	·433
22	2·00	·446
23	2·20	·458
24	2·13	·446
25	2·13	·427
26	2·27	·427
27	2·20	·451
28	2·13	·451
29	2·06	·446
30	2·13	·451

Two days after the foregoing tests were taken, the old 30-wire length between Nine Elms and Clapham was joined on to the new cable at Nine Elms, thus making a cable of 30 wires between Clapham and Waterloo, of a length of 19,800 yards, or about 3¾ miles. A fresh test made of wires Nos. 1 to 10 inclusive, from Clapham to Queen's Road, gave the following results :—

No. of Wire.	Insulation Resistance per Mile in Megohms
1	2·33
2	2·78
3	2·66
4	2·50
5	2·93
6	2·96
7	3·06
8	3·10
9	2·80
10	Not tested, being in use for working purposes.

A test of wires Nos. 11 to 40 inclusive, from Clapham to Waterloo, showed the following :—

No. of Wire.	Insulation Resistance per Mile in Megohms.	Electrostatic Capacity per Mile in Microfarads.
11	3·91	·317
12	3·97	·310
13	3·20	·310
14	3·97	·314
15	3·70	·317
16	3·45	·314
17	3·91	·317
18	4·08	·310
19	3·89	·299
20	4·02	
21	3·02	
22	3·02	
23	3·58	
24	3·58	
25	3·70	
26	3·83	
27	3·89	
28	3·93	
29	3·72	
30	3·68	
31	3 85	
32	4·05	
33	3·70	
34	4·02	
35	4·72	
36	4·10	
37	3·72	
38	3·95	
39	3·97	
40	4·12	

All the results given are those obtained at the normal temperature; the latter it was difficult to ascertain, as a portion of the pipe was exposed to the full action of the rays of the sun, and being blackened, would be a great number of degrees above the other portion, which was buried. Up to the present, no satisfactory co-efficient for indicating the alteration in resistance by change of temperature in the Brooks' cable has been obtained; it differs with every quality of oil, and also with the nature of the serving laid on the wires. The higher quality oils have a higher co-efficient of change than those of a lower grade, and in this respect the oil resembles gutta-percha. Mr. Brooks states that the co-efficient for oil and jute combined is but one-half that for the oil alone.

The figure represents a sectional view of the 40-

wire cable, and from it we can see at a glance that if we test any particular wire with all the other wires connected to earth, then the insulation resistance will be directly dependent upon the distance that the conductor of each wire is from the others, whilst the electrostatic capacity will vary inversely as this distance, hence the wires with the thicker coverings will have a higher insulation resistance and a lower electrostatic capacity than those with the thinner coverings; this is found to be the case, other things being similar.

The insulation resistance per mile of the cables, it may be remarked, is lower than that specified for and guaranteed by Mr. Brooks; but this is due to the fact that the paraffin oil with which the pipes are filled is of very common quality, obtained in England, and run in as a preliminary to the introduction of oil of a specially prepared quality. This latter oil has been supplied by Mr. Brooks, and is ready to be used should it be considered necessary at any time to increase the insulation above the present figures. As compared with the following tests of the Antwerp cable (*see* TELEGRAPHIC JOURNAL, April 5th, 1881)

No. of Wire.	Insulation Resistance per Kilom.* in Megohms.	Electrostatic Capacity per Kilom.* in Microfds.
1	211	0·095
2	164	0·140
3	185	0·125
4	152	0·133
5	179	0·138
6	173	0·146
7	133	0·135
8	164	0·135
9	158	0·143
10	146	0·130
11	164	0·130
12	133	0·140
13	133	1·135
14	164	0·133
15	133	0·125
16	164	0·140
17	133	0·135
18	185	0·130

the results may appear to be very unsatisfactory, but such is by no means the case. There is undoubtedly a very general impression abroad that high insulation is, above everything, the indication of a sound and good working line; there cannot be a greater mistake than to suppose this. In certain cases, in gutta-percha for example, excessively high insulation is an indication of a poor quality of material, a quality, in fact, which is not durable; a great deal depends upon the age of the manufactured material, it is true, but if we take two insulated wires of similar age, and in one we find a moderate insulation which will resist a high battery power for a lengthened period, and in the other we find an extremely high insulation, then we may be sure that the latter is due to a poor quality material, and that its chances of durability are comparatively small. This is not all, however, for even supposing that high insulation can be obtained consistent with durability, there is nothing whatever gained by a high result as regards its working value, in fact it is a positive advantage to have *low* insulation, provided the latter is due to the *nature* of the insulating material, and not to a *defect* in it. It is a well-known fact that speed of working on underground lines is under certain conditions increased by a defect in the insulation. Several years ago in Germany this fact was noted by Kramer, who states that he often left his bureau to put a fault on the line in order to be able to forward a despatch with greater ease (*see* Sabine's "The Electric Telegraph"). The reason of this is that a low insulation enables the static charge in a line to dissipate itself with considerable rapidity instead of slowly discharging itself at the ends of the line only, and running the signals together. But it is very necessary for thorough good working that the low insulation should not be due to a *defect*; the latter *may* improve the working, but it is much more likely to spoil it by continual variation, hence the problem to be solved in underground lines is *low* insulation (within certain limits, of course, for there must be sufficient insulation to enable a good proportion of the transmitted current to be received at the receiving end of the line) consistent with durability, and this Mr. Brooks has obtained in his new system.

Experiment shows that the Brooks' system may be employed with great advantage for telephone working; a *single* wire of the cable between Waterloo and Nine Elms has been employed as a telephone circuit for some time, and, although the other 29 wires are heavily worked, yet the inductive interference has not been such as to cause inconvenience. A telephone placed on two wires of the entire length between Waterloo and Clapham did not emit any sound, although a Wheatstone automatic instrument with high battery power was being worked on one of the other wires; the metallic loop, it may be observed, was not a twisted one, but was formed of two wires picked at random from the group of thirty. No doubt the satisfactory result obtained is in a great measure due to the fact that the relative positions of the various circuits in the pipe is different at every point throughout the length. In cases where a number of wires in a cable are employed for telephone working alone it is found that the inductive interference between wire and wire diminishes in proportion to the number of wires in the pipe, a result due, no doubt to the distribution of the effect.

The length of cable between Waterloo and Nine Elms, which has been working for several months, has not been provided with lightning protectors, although it is the general rule in the Postal Telegraph Department that all underground work shall be so fitted. No interruption has, however, been caused by lightning, although several storms have been experienced since the cable commenced working. From experiments made by Mr. Brooks it appears that if an earth fault is caused in the cable by a lightning discharge a circulation given to the oil will cause the fault to disappear; this is due, no doubt, to the carbonised matter which causes the fault and which is the result of the electric discharge, being washed away as it were, by the flow of oil; this flow, as a matter of fact, being considerably assisted by the continual changes of temperature which take place. It must be evident that the foregoing is an important point in favour of the Brooks' system, as faults in ordinary gutta-percha underground work are very troublesome to

* A kilomètre is about five-eights of a mile.

remove; the damaged wire, in fact, must be taken out of the pipe.

The length of cable between Nine Elms and Clapham was laid down by the India-Rubber, Gutta-Percha, and Telegraph Works Company, of Silvertown, under the direction of Mr. Brooks, and we understand that an arrangement has been made by which future works of the kind will be contracted for and executed by the same company.

ON THE REFRACTION OF ELECTRICITY.

By ALFRED TRIBE, Lecturer on Chemistry in Dulwich College.

(*Continued from page* 291.)

THE positions of the relatively good and bad conducting media were now reversed. The 1 per cent. solution was placed in the transmitting cell, and the concentrated in the refracting cell. An analyser at *i* recorded a non-parallel distribution, and the curvature and position of the ions showed that the course of the energy had been bent about 15°. But in this case the refraction was *from* a perpendicular to the refracting surface.

It was now natural to anticipate that the refraction, with a given incidence, would decrease or increase as the media in the refracting and transmitting cells approached or receded in conducting power. This was proved to be the case, first, by replacing the 1 per cent. solution of copper sulphate in the refracting cell by a 2, 3, 5, and 10 per cent. solution respectively, when analysers at *i* recorded respectively a decreasing refraction as the media in the cells approached equality. And, secondly, by placing a 5 per cent. solution of copper sulphate in the refracting cell, and successively a concentrated solution of copper sulphate, a concentrated solution of sodium chloride, and a dilute solution (1—11) of oil of vitriol in the transmitting cell. Analysers at *i* showed, in the case of the copper sulphate, a refraction of about 15°, in the case of the sodium chloride, 30°, and in that of the dilute sulphuric acid, 40°. The order of the increase in refraction is here the same as that of the conductivities of the liquids.

Again, it was anticipated that the refraction would decrease as the incidence decreased. This was proved to be true by setting the diaphragms so that the angle of incidence should be 45°, 30°, and 15° respectively. With a 5 per cent. solution of copper sulphate in the refracting cell, and dilute sulphuric acid in the transmitting cell, a refraction of about 35° was obtained when the incidence was 45°, about 22° when at 30°, and about 7° when at 15°.

Relation between Electric Incidence and Refraction.

That part of the electro-chemical method which has been already described supplies three means of determining the bending of the course of the energy on its passage into the refracting cell. First, by the curvature of the ions on an analyser with the shorter edges of the plate upright, and its length perpendicular to the electrodes. But the practical impossibility of obtaining accurate measurements of these curves renders this plan only roughly quantitative. Secondly, by placing an analyser at various angles to a right line joining the electrodes, until it records a *parallel* distribution. This is the case when the course of the energy is paralle with the sides of the analysing plate, and the angle inclosed between the plate and the right line referred to consequently expresses the amount of refraction. The objections to this plan are twofold. It is very tedious, and it is also difficult to determine with sufficient accuracy the angle of the plate as it stands in the cell. The refraction numbers given above were obtained by this second method, and for the last of the reasons just mentioned I regard them only as approximately correct. The third plan, based on the fact that the course of the influence, when parallel to the sides of an analyser, is perpendicular to the boundary lines of the ions set free (as described in 7) is the one I have employed for the more accurate determination of the relation between electric incidence and refraction.

I employed for this purpose four similar electrolytic cells of the shape and dimensions previously given. Pairs of porous plates were set across each of these cells, as before described, so as to give in one case an incident angle of 45°; in the second, 37½°; in the third, 30°; and in the fourth, 15°. Dilute sulphuric acid (1 to 11) was used in the transmitting cell, and a 5 per cent. solution of copper sulphate in the refracting cell. The current generally used was three Webers, though variations in this respect were found not to affect the refraction. The time of each determination was five minutes. The analysers employed were squares (24 millims. the side) of sheet silver, and discs of the same material 24 millims. in diameter. These were immersed horizontally in the centre of the refracting cell, the squares in such a way that their edges were parallel with the respective sides and ends of the rectangular electrolytic cell; the discs, so that a line passing through their centres was coincident with a line joining the electrodes.

As it has been already shown that the course of the energy in the transmitting and refracting cells was in the same horizontal plane, it was to be anticipated that the boundary lines of the ions on the analysers placed in the positions just described would be straight. Such is the case with the boundary of the negative ion, which consequently is taken for purposes of measurement.

Were the course of the energy in the inner cell identical with that in the transmitting cell, the boundary lines, in accordance with the rule in β, would be perpendicular to a right line joining the electrodes, and this might be named the zero line, or line of no refraction. And were the analysers in the position described, the zero line would be perpendicular to the central line on the discs and to the edges of the squares, which are parallel with the sides of the cell. It follows that, were the course of the energy diverted from the right line joining the electrodes (its original course) the boundary line of the ion would deviate *pari passu* from the line of no refraction. The numbers expressing this obliquity or amount of refraction in five series of trials are given in the annexed table. In Series I. II. III. square analysers were used, and for IV. and V. the discs already described.

Angle of Incidence.	Deviation.				
	I.	II.	III.	IV.	
°	°	°	°	°	°
15	9	9	9	10	9
30	19	20	19	19	20
37½	27	26	25	26	25
45	31	31	33	33	32

These *data* give the following ratios between the angles of incidence and refraction—

$$\frac{i}{r}.$$

I.	II.	III.	IV.	V.
2·5	2·5	2·5	3·0	2·5
2·7	3·0	2·7	2·7	3·0
3·5	3·3	3·0	3·3	3·0
3·2	3·2	3·7	3·7	3·4

and the following ratios between the sines of the angles of incidence and refraction—

$$\frac{\sin i}{\sin r}.$$

I.	II.	III.	IV.	V.
2·5	2·5	2·5	2·9	2·5
2·6	2·8	2·6	2·6	2·8
3·3	3·0	2·8	3·0	2·8
2·9	2·9	3·4	3·4	3·1

Taking the results as they thus appear, I think they justify the conclusion that the more probable relation between electrical incidence and refraction is as the sines of their respective angles. And further, as the experimental difficulties are overcome and the inherent sources of error appreciated, this relation may be still more rigidly found to obtain.

This electro-chemical method being new, it would be well to supplement, if possible, the evidence it has furnished of the laws of electric refraction by one based on more familiar principles. I am engaged in perfecting a method founded on those employed by De la Rive in 1825, and by Professor Adams in 1875, for investigating the laws of electric distribution in electrolytes, which I believe will demonstrate in another way the main facts set forth in this communication.

Conclusions.

I. Electricity passes without alteration of direction from one electrolytic medium to another differing from it in conductivity, when the course is perpendicular to the surfaces of contact.

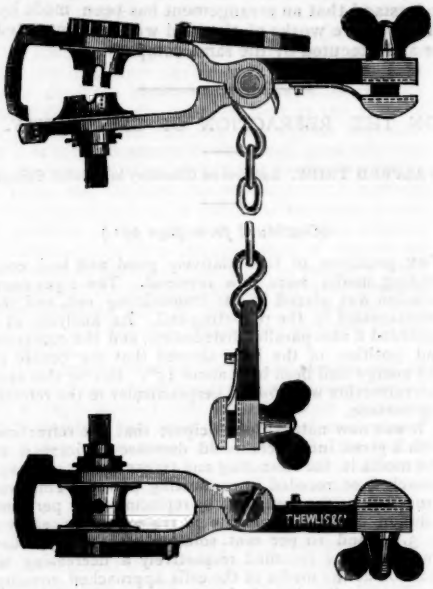
II. Electricity, on passing obliquely from one medium to the other, suffers refraction, and in the same plane; towards the perpendicular, when from a better to a worse conductor, and from the perpendicular when from a worse to a better conductor.

III. The refraction increases or decreases as the media recede from or approach one another in conductivity.

IV. The refraction increases as the incidence increases.

FLETCHER'S PATENT DRAW VICE.

THE peculiarity of this new form of draw-vice consists in the fact that it enables linemen to strain up telegraph wires, when constructing or repairing a line, without the use of a second draw vice or any of the usual means for securing the wires which have hitherto been employed. The new draw vice, which is shown by the figures, is provided with a split drum on which the slack is wound and which can be emptied as often as required, so that any amount of sag can be pulled up. When the drum is full, the wire is secured by the small vice and chain, and the catch knocked off with a key,



when the surplus wire can be removed from the drum and cut off; this being done a fresh hold is taken and the drum again filled and emptied until all the slack wire has been drawn in and proper regulation obtained. Messrs. Thewlis and Griffith, of the Phœnix Works, Warrington, are the sole manufacturers of the new implement, which is the invention of Mr. Fletcher, the Engineer to the North Western Railway Company.

DESIGN FOR A TELEGRAPH CABLE SHIP.

THE register dimensions for this design are as follows:—Length 230 feet, breadth 32 feet, depth of hold 17 feet, and a gross register tonnage of about 1,000 tons. The ship is specially designed for the purpose of laying and repairing submarine cables, and possessing the most suitable accommodation for those in charge and the crew. The vessel is arranged for a pair of compound (high and low pressure) marine engines, working at 1,100 indicated horse-power, and capable of driving her at a speed of 13·5 knots at sea; they are placed well aft so as to get the principal cable tanks in the fore-part of the ship clear of the screw shaft. The boilers are two in number, of the cylindrical multi-tubular description, and possessing heating surface large enough to supply the engines with all necessary steam. In the boiler-room are two smaller boilers, one or both

for the ordinary work of the ship's winches, steam capstan, steam-steering gear, &c., and both combined in connection with the forward cable gear. Immediately ahead of the boiler-room is the large main tank, it is circular, and water-tight, right up to the main-deck, with a water-tight manhole on the forward side, which may be opened when necessary, so as to pass cable between decks. In the centre of this tank is a telescopic iron cone suitable for keeping fresh water in, if going on a long voyage. The feed and discharge pipes from this tank, as well as all the tanks, are connected with a special donkey pumping-engine, situated in the engine-room, and under the management of the ship's engineers (deck-pumps, driven by steam winches generating noise, and requiring lengths of hose, being thus avoided). This tank is 31 feet in diameter, and 15 feet deep, and capable of holding 280 knots of deep sea cable without difficulty, and therefore occupies the main cable-carrying capacity of the ship. The next tank has a special feature, inasmuch as it consists of a double tank, placed one inside the other, the outer one being the full width of the ship at this part, while the inner is also circular (18 feet in diameter) and contains the grapnel rope. The small tank forward for the picked-up or other cable is placed on the top of the water-ballast tank, and all three tanks are made as large as the form of the vessel will permit. There is another tank aft, just forward of the saloon, and principally used for holding "shore end," or the heavier type of cable, but it is handy for any kind that may come to hand. The black line going aft from the main tank indicates the cable as it passes through the eye of the tank, over the guide pulleys on deck, through the alley-way on the port side to the jockey machinery, where any tendency to kink is taken out of it, or in other words, it is straightened, before taking three or four turns round the paying-out drum, after leaving which, it passes over a guide-pulley, underneath the dynamometer, and over the stern pulley into the sea.

It will be seen from the deck plan, that the cable, and all after paying-out gear connected with it, is kept well out to the ship's port side; by this means we get all the available space that can be had on the main-deck, either for working the ship or any other purpose. On the other side of the ship, and opposite the stern pulley, is placed Sir W. Thomson's large and small sounding machines, for the purpose of making a careful survey of the bottom of the sea.

At the forward end of the ship is the picking-up repairing gear. Here again a full line indicates the direction of the cable as it is picked up over the bows of the vessel and passed into the double tank. Beginning at the bow sheaves (of which there may be two or three, some telegraph engineers preferring the one number, and some the other), we pass inboard to the dynamometer, which is placed midway between two sets of guide-pulleys, the one on the raised forecastle-deck, and the other on the main-deck, elevated to the same level. This dynamometer, as in the case of the one aft, is used for measuring the strain brought to bear on the grapnel rope or cable. Close to the bow sheaves extends a light iron grating platform for men standing on and manipulating the work of grappling and picking-up, &c. The top of the picking-up drum just appears about 12 inches above the main-deck, while the whole of the machinery, consisting of a pair of strong horizontal engines, is firmly fixed on the lower deck, which is specially strengthened to support them. The engines receive steam from two smaller special boilers (before mentioned), or from the main boiler as desired, while the whole of the starting handles and brake-gear for manipulating the compound right and left-handed gear are so conveniently placed on the main-deck that one man, by watching the large dynamometer scale (which is marked with large figures on its aft as well as its forward side), and the directions of the engineer or officer in charge, can manage them with ease. Suitable draw-off gear for pulling the cable when it has passed the picking-up drum towards one or other of the tanks is fixed, but not shown. A light narrow gangway extends from the bridge-deck to the forecastle-deck for the convenience of those in charge passing to and fro between the chart room and the working or grappling-deck, and this greatly facilitates the observation and guidance of the work.

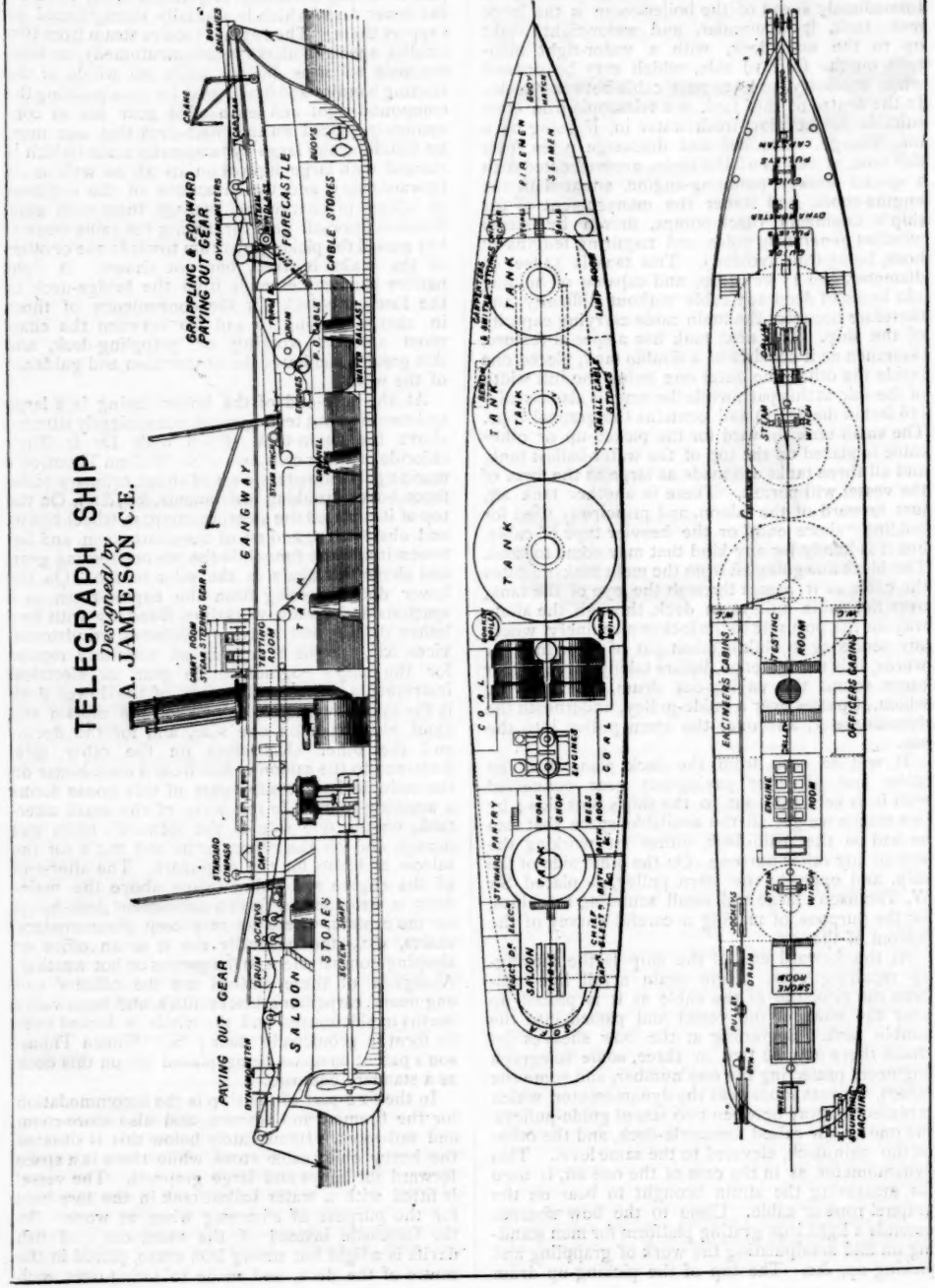
At the fore-end of the boiler casing is a large and commodious testing-room, conveniently situated above the main-tank (fitted with De la Rue's chloride of silver cells, two of Sir William Thomson's marine galvanometers, a set of slides, ordinary resistance boxes, speaking instruments, &c., &c.). On the top of it is placed the steering compass, wheel-house, and chart-room, and aft of the chart-room, and between it and the funnel, is the steam-steering gear, and above that again is the pilot bridge. On the lower deck, entering from the engine-room, is a spacious and handy workshop, fitted up with two lathes, drilling and slotting machines, grindstones, vices, &c., capable of making all necessary repairs for the ship's engines, cable gear, or electrical instruments. On the after-part of the lower deck is the saloon, with state-rooms for the captain and chief electrician on one side, and for the doctor and the other electricians on the other side. Entrance to the saloon is had from a deck-house on the main deck; the after-part of this house forms a smoking-room. In the wake of the small after-tank, on the one side is the steward's room and pantry, and on the other, baths and w.c.'s for the saloon, and also for the engineers. The after-end of the engine and boiler casing above the main-deck is extended to form a convenient deck-house for the captain, where he may keep chronometers, charts, &c., and generally use it as an office or sleeping compartment in dangerous or hot weather. Alongside of these casings are the officers' and engineers', carpenter's, blacksmith's, and boatswain's berths in sidehouses, and the whole is decked over to form a promenade deck; Sir William Thomson's patent compass being placed aft on this deck as a standard compass.

In the fore-part of the ship is the accommodation for the firemen and seamen, and also store-room and sail-room. Immediately below this is situated the heavy chief cable store, while there is a space forward for buoys and large grapnels. The vessel is fitted with a water ballast tank in the fore-hold for the purpose of trimming when at work. On the forecastle instead of the usual cat and fish davits is a light but strong iron crane, placed in the centre of the deck, and made to swing over each

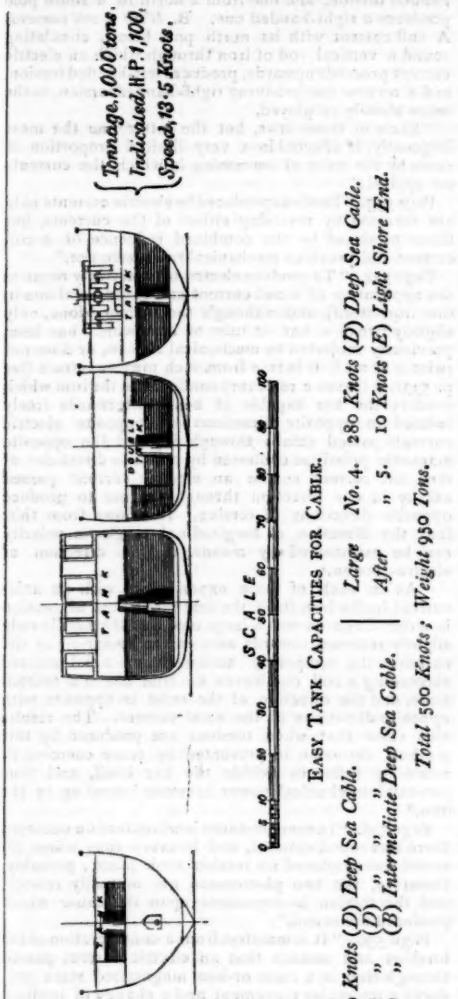
TELEGRAPH SHIP

Designed by

A. JAMIESON C.E.



bow. The rope may be worked by the steam windlass for heavy lifts. It is very suitable for elevating or lowering the anchor or grapnels, or



EASY TANK CAPACITIES FOR CABLE.

Forward No. 1.	100 Knots	(D) Deep Sea Cable.	Large	No. 4.	280 Knots (D) Deep Sea Cable.
Inner " 2.	50 "	(D) " " Deep Sea Cable.	After	" 5.	10 Knots (E) Light Shore End.
Outer " 3.	60 "	(B) Intermediate Deep Sea Cable.			
		Total 500 Knots; Weight 950 Tons.			

for hoisting the buoys out of the fore-peak on to the deck, and may be easily lowered flat on deck when desired. Immediately behind it is the capstan, wrought by a chain from the steam windlass, which is on the main-deck at the break of the forecastle, between the extended wings.

The first consideration in the design has been the separate stowage of as much cable as possible of the different types required, compatible with the size of vessel; secondly, the easy manipulation of the same, whether for paying out or repairing purposes, with large commodious forward working deck; thirdly, great steaming power, so as to arrive on the ground with as little delay as possible; and fourthly, the comfort of those in charge as well as the crew consistent with operations in warm climates.

I have to acknowledge the assistance of Mr. Logan, draughtsman to Messrs. Aitkin & Mansel, shipbuilders, Whiteinch, Glasgow, in preparing scale plans.—A. J.

[The illustration in the foregoing description is from the design shown by Mr. A. Jamieson, Principal, College of Science and Arts, Glasgow, at his lecture on "Laying and Repairing Cables," Naval and Marine Engineering Exhibition, Glasgow. We have so often heard of old steamers being turned into telegraph ships, and going at a snail's pace, with all sorts of inconveniences, that we shall be happy to receive from our readers any criticisms or plans of other cable ships and cable gear. —ED. T. J.]

Correspondence.

TELEPHONE PERTURBATIONS.

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—Your correspondent "Induction," in his letter to you dated 23rd ult., raises certain points which, with your kind permission, I shall endeavour to answer very briefly.

First, "Is it correct to say that the wind 'sets up currents' in the wires? Are not these peculiar noises, if they are really caused by the wind, simply waves of sound?" In my previous communication, which you were good enough to publish, I said that these sounds were probably caused by the currents set up in the wires by the vibratory motion imparted to them (in a magnetic medium) by the wind. I think the experiments of M. Gaiffe and others show that these sounds are due to electrical rather than mechanical causes.

Secondly, another series of experiments confirms the accuracy of what I have already stated, namely, that when telegraph and telephone circuits are put to the same earth-plates the working of the former is reproduced in the latter.

The telephones used in the experiments were the Bell and the Gower-Bell.

The resistances of the earth 0·3 and 1·3 ohm respectively, and neither of them ran for any distance alongside wires in actual use.

Thirdly, I have failed to learn that any telephone company, or even the Post-Office, expects its renters to examine the connections of their apparatus when a fault occurs. Not sharing "Induction's" elevated opinion of the average lineman and his detector, I am inclined to believe that, given a few ample practical rules, the renter with his galvanometer could be as much relied upon for making tests and not leaving his apparatus short-circuited. If the renter could do no more than state in his "Advice of Interruption" that

the fault was or was not at his office, surely he would indicate where the lineman should or should not be sent.

But every town and village does not possess its lineman, and it is to renters in such unhappy places that galvanometers would be most useful, saving, as they undoubtedly would, unnecessary visits of the lineman with his "detector," time and inconvenience.

"The cost of the galvanometer and the resistance they add to the circuit are considerations *so important* that even on short telegraph circuits their use has been abandoned."

If I am not misinformed, the case referred to is an isolated one, and although there are no galvanometers, there are two wires between the offices, and at one of the offices there is every facility for testing. Again, if galvanometers are so objectionable on short lines, they must be equally so on long ones, and no mention is made of their removal from the latter or from the short circuits already supplied with them.

Yours faithfully,

TELEPHONE.

MOLECULAR TORSION AND MOLECULAR MAGNETISM.

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—Having recently noticed that some of the chief facts in a paper on "Permanent Molecular Torsion of Conducting Wires produced by the Passage of an Electric Current," published in your TELEGRAPHIC JOURNAL of April 15th, 1881, and described in that paper as being "new," and also some additional ones contained in a paper on "Molecular Magnetism" in your periodical June 1st and 15th, 1881, were previously observed and described in a communication on "Electro-torsion" in the Phil. Trans. of the Roy. Soc. for the year 1874, I shall feel obliged if you will make equally known the following remarks.

In the paper on Electro-torsion it was shown that the passage of electricity through an iron or steel wire changes the structure of the metal and communicates to it a permanent molecular twist, and in addition, that this molecular twist produces a visible movement of the free end of the wire turning in the direction of the twist it has received; and thus not only have the molecules in some extraordinary way rearranged themselves into a permanent twist, but have also given external indication of so great a change having taken place. Also that the strain, which remains a constant, instantly disappears or diminishes upon the production of longitudinal magnetism in the wire.

Various other facts, such as the necessity of having a magnetic metal; that the action of electricity in producing a permanent strain in iron is exceedingly quick; that longitudinal magnetisation was also quick in reducing the strain; that a constant movement of the iron wires of telegraphs by this electro-torsional action tends to occur; and that these torsional states are related to electro-magnetic sounds, &c., &c., are there recorded. The following are some quotations from that paper:—

Page 531. "The torsions may be produced:—(1st) By the passage of axial currents alternately in opposite directions; (2nd) by the alternate passage of coil currents and axial ones; (3rd) by the simultaneous passage of both; and (4th) by the temporary passage of an axial current during the continuance of a coil one, or *vice versa*. The first and second methods yield only very small torsions, and the third and fourth produce exceedingly large ones."

Page 532. "I tried wires of platinum, silver, copper, lead, tin, cadmium, zinc, magnesium, aluminium, brass and German silver, also a zinc rod 2·75 mm. long and 11 mm. thick, and applied the currents in various ways, but obtained no signs of torsion."

Page 532. "The law of the phenomena in iron is as follows:—A. *With an axial current.* A current following from a south to a north pole produces a left-handed torsion, and one from a north to a south pole produces a right-handed one. B. *With a coil current.* A coil current with its north pole below, circulating round a vertical rod of iron through which an electric current proceeds upwards, produces left-handed torsion, and a reverse one produces right-handed torsion, in the sense already employed.

"Each of these laws, but the latter one the most frequently, is affected in a very limited proportion of cases by the order of succession in which the currents are applied."

Page 533. "Torsions produced by electric currents only are reversed by reversing either of the currents, but those produced by the combined influence of a coil current and previous mechanical twist were not."

Page 534. "To produce electro-torsion freely requires the application of a coil current and of an axial one in the iron itself, and although the former alone, only slightly twists a bar or tube of iron which has been previously subjected to mechanical torsion, or does not twist it at all if it is free from such previous strain (*see* p. 533), it leaves a residuary condition in the iron which renders the bar capable of being afterwards freely twisted in opposite directions by opposite electric currents passed axially through it; and the opposite magnetic polarities conferred by opposite directions of the coil current enable an electric current passed axially in one direction through the bar to produce opposite directions of torsion. It follows from this, that the direction of longitudinal magnetic polarity can be ascertained by means of the direction of electro-torsion.

"As in each of these experiments with an axial current in the iron itself the first movement of torsion in either direction was a large one, and the needle only slightly returned towards zero on the cessation of the current, the temporary action of an axial current succeeding a coil one leaves an iron bar in a twisted state, and the direction of the twist is opposite with opposite directions of the axial current. The results also show that when torsions are produced by this method, detorsion is prevented by some coercive or retaining influence within the bar itself, and thus potential mechanical power becomes stored up in the iron."

Page 536. "In every instance in which torsion occurred there was sound emitted, and in every case where no sound was produced no torsion took place; probably, therefore, the two phenomena are mutually related, and the torsion is dependent upon the cause which produced the sound."

Page 536. "It is manifest from a consideration of the torsions and sounds that an electric current passed through iron in a more or less magnetised state produces a molecular movement and a change of position of its particles, and that the new position continues as long as the current. Also that on the cessation of the current the particles make very little movement, and return only a small extent towards their original positions, because little or no sound occurs, and only a small amount of detorsion then takes place. Also that an electric current in the opposite direction produces a similar set of changes, except that the changes are in the reverse direction."

Page 537. "It must not be forgotten that in all these experiments terrestrial magnetism operates, and more or less influences the results; also that the iron is liable to have its residual magnetism weakened by the repeated passage of an axial current in either direction through it, and if the lower end of it is a north pole, the polarity is often reversed. A single contact of the

battery is sufficient to remove the polarity if the current is powerful and the iron wire a small one.

"In consequence of not being able to maintain a bar or wire of iron perfectly free from longitudinal magnetism during the passage of an axial current through it whilst in a vertical position, and the difficulty of detecting minute torsions with the bar in a horizontal one, I was unable to ascertain if an axial current alone would produce torsion by experimenting with a demagnetised iron bar at right angles to the magnetic meridian. But as the magnitudes of the torsional effects of an axial current increase with the strength of the longitudinal magnetic polarity of the iron, and opposite longitudinal magnetic polarities enable each axial current to produce opposite torsions, it is highly probable that if a vertical iron rod or wire could be maintained in as perfectly a magnetised state in a longitudinal direction as it can in a transverse one, an axial current alone, like a coil one alone (*see* p. 533), would produce little or no torsion."

Page 540. "The sudden cessation of torsion after the first axial current in steel, and the much more gradual cessation of it in iron, are quite conspicuous. The fact that the magnitudes of the first torsions, both in iron and steel, are smaller with a north pole below than with a south one, agrees with the view that the magnitude of the movements depends upon that of the residuary longitudinal magnetism."

Page 541. "To produce torsion freely requires the two currents (*see* section 10, p. 535), and, although each current alone will produce its own magnetic effect, neither alone will twist the bar if the iron is free from mechanical strain. The results also show that, although a coil-current alone produces no torsion in an annealed iron bar (*see* p. 533), the previous passage of a current axially through the bar puts the iron into such a magnetic state that it becomes capable of being afterwards freely twisted in opposite directions by opposite coil currents, and that opposite axial currents cause the iron to assume two opposite directions of such state, because they enable one direction of coil current to produce opposite directions of torsion. The results further show that the two ends of an iron rod, wire, or tube, through which an electric current has been axially passed, possess opposite properties.

"It appears, also, that each of the opposite longitudinal magnetic states produced by the two directions of coil current is different from each of the conditions produced by opposite axial currents, because previous magnetisation of an iron bar by a coil current in either direction did not enable the subsequent magnetisation of that bar by an opposite coil current to produce twist, whereas the previous passage in either direction of an axial current through it did enable such subsequent treatment of it to produce torsion; and, further, because an axial current does not lengthen an iron bar (*see* p. 530), but a coil current does; the acoustic effects of the two directions of current are also different (compare section 12 and 23). All these conclusions agree with the view that the axial current imparts poleless magnetism tangentially to the outer layer of molecules of the iron, and that each of the four different directions of current imparts to the free end of the iron a different property.

"As in each of these experiments with a coil current the first movement of torsion was a large one, and the index returned only a small distance back on cessation of the current, the temporary action of a coil current succeeding an axial one (like that of an axial current succeeding a coil one, *see* section 10) leaves an iron bar in a twisted state; and the direction of that twist is opposite with opposite directions of the coil current. By this method, therefore, as well as by the previous one (*see* section 10), detorsion is prevented by some influence within the bar, and mechanical power becomes stored up.

"The results of these experiments, and of those previously described (*see* section 10), show that the direction of torsion in all of them depends upon that of each of the two currents, and that it was reversed by reversing either the axial or coil current, but not by reversing both. They also prove that the directions of torsion produced by a coil current succeeding an axial one are identical with those produced by an axial current following a coil one."

Page 542. "The magnitudes of the torsion produced by coil currents succeeding axial ones averaged about two-fifths of those produced by axial currents succeeding coil ones."

Page 543. "The magnitude of the torsion produced by a given current depends not only upon the kind of current which immediately precedes it, but also upon the description of current which precedes that one. An axial current in a given direction succeeding a coil one nearly always produced a greater torsion if the coil one was preceded by an axial one in the opposite direction than if it followed one in the same direction. A similar but less general result occurs with coil currents succeeding axial ones.

"Alternate coil and axial currents, therefore, produced the largest torsions when both kinds of currents were alternately reversed in direction. The torsions in general produced by alternate currents appear to be due not only to the energy of the acting current, but also to the liberated potential energy of the residual magnetism left by previous currents."

Page 544. "In every instance a coil current acting alone produced a sound, both at its commencement and termination, the former being the loudest and the latter more metallic; and by repetition of the current in the same direction the two sounds were more feeble. Coil currents succeeding axial ones also produced sounds both at their commencement and cessation, the former being in every case louder and more dull, and the latter feebler and more metallic (*see* also section 24), and by repeating the coil current in the same direction the two sounds were more feeble.

"The residuary axial current state is destroyed by a red heat, and is but little restored by cooling the wire whilst in a direction at right angles to the terrestrial magnetic meridian."

Page 545. "As an axial current passed through a recently annealed rod of iron or steel leaves it in a different physical state (without twisting it), and one succeeding a coil current leaves the bar in a twisted condition, it is evident that iron possesses a retentive power, not only for the influence of a coil current, but also for that of an axial one, and that the residuary axial current state may exist with or without the condition of twist.

"In consequence of this retentive power of iron and steel for those effects, both the direction and the magnitude of the torsions in every case depends not only upon the kind and direction of the currents being applied, and upon the condition of the rod with regard to previous mechanical strain, but also upon the state of it with regard to both those residuary influences."

Page 546. "It required more persistent treatment to remove the residual effect of a coil current than that of an axial one, probably partly because the influence of terrestrial magnetism assisted in maintaining the former and in removing the latter.

"Although it requires a *series* of alternately opposite axial currents to remove the residual effect of a coil one, and a *number* of alternately reversed coil currents to remove that of an axial one, a single opposite coil current, also a single opposite axial one, each of sufficient power, respectively produce those effects. It

would appear from this that the two states produced by opposite coil currents (or axial ones) are incompatible and cannot co-exist, and that a coil current acts in a more mechanically advantageous way in obliterating the effect of an opposite coil current than in removing that of an axial one, and an axial current acts more effectively in effacing the influence of an opposite axial one than in reversing or removing that of a coil one."

Page 547. "The residual effect, both of a downward and of an upward axial current, was much more persistent in steel than in iron, and we may conclude that steel possesses in a greater degree than iron a coercive power for the influence of an axial electric current."

Page 548. "The magnitude of the first torsion produced by a current is specially liable to be affected by various mechanical and magnetic conditions of the axial wire or rod, which may be very readily overlooked."

Page 549. "The largest torsions were produced by axial currents, and the smallest by coil ones; therefore the former left the smallest residual effects."

Page 552. "As real torsion and detorsion can only be detected and measured by the aid of a proper zero-point, it is necessary to have the wire well annealed and free from magnetism and mechanical twist before commencing a series of experiments, and not to disturb the zero-point by mechanical motion of the apparatus. A very effectual way to remove the residual effects of both coil and axial currents is to heat the rod or wire to redness whilst in a direction at right angles to the magnetic meridian, and allow it to cool in that position without disturbing it (*see* section 24). A more convenient but less perfect way is to repeatedly and simultaneously pass a coil current producing a south pole below, and an axial one of proper relative strength (*see* section 37, p. 555), and stop the two currents simultaneously; the pointer will then settle very near zero, and the wire will only possess the usual magnetism induced by terrestrial influence.

"The two conditions, or rather directions, of magnetic condition were observed to co-exist in the same wire in many of the experiments. All rods or wires of iron or steel in which there remained the effect of an axial current were at the same time in a more or less longitudinally magnetic state by the influence of terrestrial magnetism, and could then be twisted by the application either of a suitable coil current or of an axial one.

"The view that the two conditions are to some extent distinct and independent agrees with the fact that a suitably powerful coil current *at once* removes and reverses the residuary longitudinal magnetic polarity in a soft iron wire, but only gradually removes the residual effect of an axial current, and does not at all reverse it (*see* section 27). Each axial current also transmits its own characteristic influences through several subsequent coil current changes, and each coil current similarly through axial current changes, in a kind of hereditary manner."

Page 553. "There was a special difference between the torsions produced by alternate currents and those yielded by simultaneous ones. In the former case, on cessation of the current, the pointer only slightly returned towards zero, and the wire remained twisted (except in a limited number of special instances, *see* section 20, p. 542, and section 32); on repeating the current in the same direction only the small elastic torsions occurred, and the large movements in the same direction could only be obtained by reversing the current, and then again repeating it in the original direction. But with the two currents flowing simultaneously, on stopping them the index returned nearly to zero, and the wire did not remain twisted; on repeating the currents in the same direction the very large torsion in the original direction was again produced; and any number of such torsions could be consecutively obtained without any intervening reversal of the currents. It is evident, therefore, that the coercive force or condition within the bar which retains the iron in a twisted state after the passage of alternate coil and axial currents is either overcome or does not operate when simultaneous currents are employed."

Page 554. "The very much greater magnitude of the torsions obtained by simultaneous coil and axial currents was probably a consequence of the two magnetic conditions being very much stronger during the continuance of the currents than after their cessation. Not unfrequently with an iron wire 1·75 mm. thick the first movement of the index exceeded 25 millimetres. The torsional push is not limited to a small angle, but continues through the entire range of the largest arc through which the pointer can be made to swing, even though that exceeds one-third of a circle."

Page 554. "With the two currents commenced together and terminated also simultaneously, the index made a very large movement at the commencement of the currents, remained considerably (though much less) deflected during their continuance, and returned nearly to zero on their cessation, provided the two currents were of proper relative degrees of strength."

Page 555. "Simultaneous and divided currents on the first time of passing produced a loud and dull sound on making contact, and a weaker and more metallic one on breaking contact, but by each repetition in the same direction the reverse, and their first passage produced louder sounds than their repetitions."

Page 555. "As the magnitude of the torsions produced by simultaneous currents depends upon both currents, and is therefore limited by the weakest, the two currents must be properly proportioned to each other in order to produce the maximum degree of torsion."

Page 556. "Iron is extremely susceptible of being affected by an electric current, and consequently every different way of applying the two currents produces a difference of effect upon it."

Page 557. "A non-magnetised iron wire is not visibly twisted by a powerful coil current (nor axial one) alone, but acquires an invisible potent condition which reveals itself by torsion on the subsequent passage of suitable currents."

Page 557. "A general review of the phenomena described in this paper shows that the hereditary action and order of succession of the various currents affects the torsions in all cases."

Page 558. "It would appear from the results obtained that in iron the residuary torsional influence of the currents generally is about one-tenth of that exerted by them during their continuance. In steel it would be a much greater proportion in consequence of the comparative smallness of the torsions yielded by that substance with simultaneous currents."

Page 559. "Except with alternately opposite coil currents succeeding an axial one, iron is much better adapted than steel for producing large torsions.

"It is probable that the generally smaller torsions obtained with steel than with iron was partly due to the greater degree of mechanical resistance which that substance offers to torsion, and partly to its differences of magnetic properties and chemical composition. Electro-torsion, therefore, affords prospectively a new method of investigating the mechanical and magnetic properties and the chemical composition of magnetic metals."

G. GORE.

CITY AND GUILDS OF LONDON INSTITUTE EXAMINATIONS.

To the Editor of THE TELEGRAPHIC JOURNAL.

DEAR SIR,—The results of the Examinations for 1881 have just been issued, and are far from encouraging, either to teachers or students after six months' work. In my opinion, this result is chiefly due to the limited instructions issued to teachers. I would ask, why cannot a printed syllabus be issued, stating how far the students in each grade will be examined? This is done by the Science and Art Department, and the results are far more encouraging, as all know their work and do it, instead of rambling about in the dark all over a subject, as is the case at present, instead of concentrating all their attention each session on what is really required. It is to be hoped something of the kind will be issued for future guidance.

Yours truly,

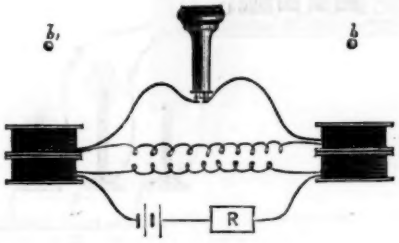
A STUDENT.

Notes.

THE BROOKS' UNDERGROUND SYSTEM.—On page 306 we give an account of the tests taken on the new length of this cable, put down between Vauxhall and Clapham Junction. The importance of this system appears to be growing from day to day. Its inventor claims for it, and justly so we think, that it has the following advantages, viz:—1st. Durability when compared with all other kinds of insulation. 2nd. Economy, because the ordinary number of conductors at present in use upon the railways in Great Britain could be renewed by this system at a less cost than by overhead wires. 3rd. That the chances of interruption in comparison with overhead wires are enormously lessened. 4th. That the insulation of the wires is uniform, and (by the use of oils of various insulating properties) can be raised or lowered at pleasure. 5th. That low inductive capacity can be simply and cheaply obtained by enlarging the jute covering, thus enabling long circuits to be worked at a high speed by automatic means. The above *desiderata* will, we think, be deemed important, and the system seems to bring into view a near future, when unsightly, and ever increasingly dangerous, overhead wires will be among the things of the past, and when probably telegraph rates will, through increased speed and economy, be reduced from one shilling to at least half that price.

PORTABLE ELECTRICITY.—At the Academy of Buda-Pest certain experiments with stored-up electricity were lately conducted in presence of the professors, members of the administration, &c. It is said to have been proved that electricity can be stored up just as well as light, gas, steam, &c., and that it can be transported in this state. The experiments were conducted with 50 Faure's accumulators, and consisted in igniting platinum and iron wires, the production of electricity and its effects, and in the conversion of electricity into mechanical work. With these accumulators and with the help of a Gramme machine, a circular saw was set in motion and several logs of wood were cut up. The French firm who had these experiments performed maintain that the expense is 10 kreuzer per horse-power per hour.—*Oesterr Ungarische Post.*

THE LOCALISATION OF THE BULLET IN PRESIDENT GARFIELD'S BODY.—The daily papers have announced that success has attended the method suggested by Professor Hughes for localising the bullet in the body of President Garfield. The arrangement for effecting the object in view is of a very simple nature, and can be easily understood by reference to the figure. Two induction coils, each having a primary and secondary wire, have their primaries connected in circuit with a battery and a rheotome (R), so that a number of current pulsations are continually flowing through the primaries. A telephone is joined in circuit with the two secondary wires, the connections being so much that the induced currents from the secondary coils tend to oppose each other and produce silence in the telephone. If now a bullet or mass of metal be brought near one of the



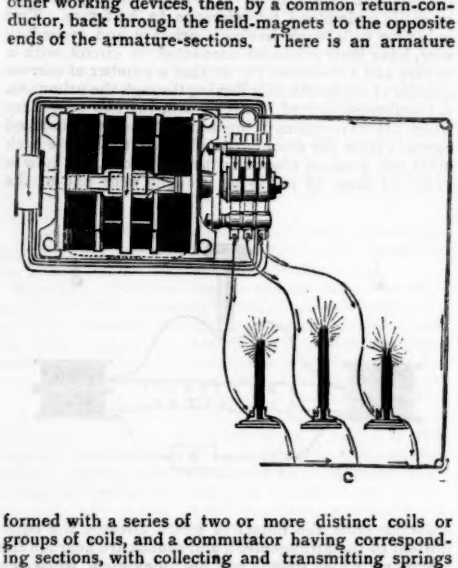
induction coils, the inductive effect disturbs the equilibrium of the arrangement, and sounds are heard in the telephone, which sounds will be a maximum when the mass of metal is nearest the coil. By adopting, therefore, the arrangement shown in the figure, and moving the left-hand coil over the locality of the bullet, b_1, in the President's body, the point at which the sound was heard to be loudest indicated the nearest point to the bullet. To ascertain the depth of the latter from the surface, it was only necessary to hold a second bullet, b, near to the second induction coil, and then to advance or retreat it until silence in the telephone was produced, when the distance of b from the coil indicated at once the depth required. We must congratulate Professor Hughes on the success of the experiment.

CHROMIC ACID ELEMENT.—Chromic acid elements have the great advantage of simplicity, and their consumed portions are easily replaced, but the consumption of materials is in all cases disproportionately great. The reason of this defect is that on the contact of the zinc with the sulphuric acid of the chromic acid mixture, hydrogen is evolved and is then oxidised to water by the oxygen of the chromic acid. If this secondary process can be suppressed the mixture is at an end. By the decomposition of chromic acid by the hydrogen evolved in the element there is formed potash chrome-alum. This salt has a higher specific gravity than the solution of chromic acid, and sinks to the bottom along with the solution of sulphate of zinc.

If, therefore, the zinc is laid at the bottom of the glass jar, it is protected from direct contact with the chromic acid. Instead of a zinc plate it is better to use a liquid zinc amalgam, which may be placed in a small, shallow beaker in the bottom of the jar.

Such elements last very long; they are powerful, and if the surface of the carbon is large enough, more powerful than the Leclanché element, and cheaper.—*Zeitschrift für angewandte Electricitäts Lehre.*

A PATENT for a dynamo-electric (No. 243,746, dated April 7th, 1880) has recently been taken out in the United States by Mr. J. J. Wood. In this machine, which is shown by the figure, the circuits from the armature-sections are taken separately to the lights or other working devices, then, by a common return-conductor, back through the field-magnets to the opposite ends of the armature-sections. There is an armature



formed with a series of two or more distinct coils or groups of coils, and a commutator having corresponding sections, with collecting and transmitting springs which can be combined with a series of two or more lamps each connected on one side with one of the springs on one side of the commutator, and all connected on the opposite side to one common or main conductor connected with the several springs.

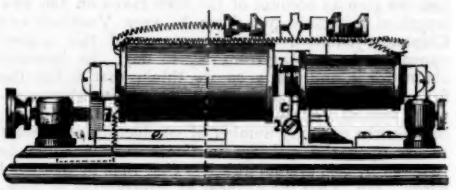
GALVANIC DISSOLUTION OF GOLD.—Grotthus, in his experiments on the decomposition of water by means of the battery, observed the solution of a gold wire used as a positive pole in sulphuric acid traversed by the current. Berthelot has recently repeated this experiment with the same results. Sulphuric acid, diluted to one-tenth, turns yellow and rapidly dissolves a gold wire. The dissolved gold may easily be detected by means of stannous chloride, and a part of the gold is deposited at the negative pole. The attack of gold by means of sulphuric or nitric acids is not due to the intervention of ozone, but simply to the electric current.—*Il Progresso.*

UNITY IN ELECTRIC MEASUREMENTS.—The want of an international system has been strongly felt, and the multiplicity of the measures in use is alarming and confusing. We find electromotor forces expressed in Daniell, Grove, Bunsen, Regnault, Volt, Siemens x Weber, &c.; strengths of current in Jacobi, Weber, $\frac{\text{Daniell}}{\text{Siemens}}$, $\frac{\text{Grove}}{\text{Siemens}}$, &c. Those measures are particularly unhappy which are compounded of heterogeneous systems, *e.g.*, Siemens x Weber. We generally console ourselves with the thought that 1 S. E. is about as much as 1 Ohm, 1 Daniell about equal to 1 Volt, and 1 $\frac{\text{Daniell}}{\text{Siemens}}$ approximately equal to 1 Weber, though we here commit an error of 7 per cent. What would be thought of an engineer who mixed up Rhenish and English measures? We must admit that the introduction of a universal system of electric measurement is extremely difficult. Measures of length and weights are produced with great uniformity and certainty by our wardens of the standards, but the preparation of normal electric measures is far more difficult. Above all, a trustworthy normal element is wanting. In order to produce anything useful, it would be necessary to intrust an international committee with the arrangement and management of the manufacture of such normal elements. If the conditions for attaining equality and constancy of the electromotive forces were once thoroughly understood, it would be possible for a carefully-conducted manufacture to supply the whole world with a suitable measure. Standard galvanometers could also be supplied.

A further task for a congress of electricians would be the establishment of symbols to be used in equations for the different measures.

Not merely in the system of measurement, but in electric terminology there is enough confusion. The term intensity is applied by one authority to the strength of the current, and by another to the electromotive force of the electromotor. Others use the words: tension, electromotive force, and potential difference in manifold confusion.—*Zeitschrift für angewandte Electricität.*

THE figure here given represents an electromagnetic apparatus patented in the United States (patent No. 244,035, dated February 9th, 1881) by Mr. Moses G. Crane. In this apparatus there is a main electro-magnet and induction coil, the primary coil of which is in the main circuit, combined with the inde-



pendent retracting-magnet in circuit with the secondary coil of the said induction-coil, whereby a magnetic impulse is produced in the said retracting-magnet when the condition of the main current in the primary coil is changed, so that the effect of a reversal in the main current is effected although no reversal takes place.

REYNIER'S CONSTANT ELEMENT.—The liquids used in this battery have been till lately kept secret. The zinc plate is immersed in a solution made up as follows:

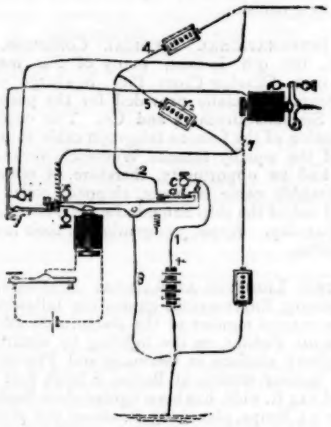
1,200 parts water, 300 parts carbonate of soda, 100 parts carbonate of potash, 20 parts chloride of potassium, 20 parts chloride of sodium, 20 parts "kalium-chloride" (merely another name for chloride of potassium), and 20 parts common salt! (Which is of course the same thing as chloride of sodium.)

The copper plate is placed in a still more complicated mixture of 1,200 parts water, 240 parts blue vitriol, 60 parts nitrate of copper, 20 parts chloride of potassium, 20 parts chloride of sodium, 20 parts "kalium chloride," 20 parts common salt (a repetition of the blunder above mentioned), 20 parts saturated solution of chloride of zinc, 20 parts sulphate of potash, 20 sulphate of soda, and 20 sulphate of zinc. (We cannot compliment M. Reynier on his chemistry.)—*Zeitschrift für angewandte Electricität.*

THE Cunard s.s. *Servia* is being fitted with 98 of Swan's electric lamps.

A PRACTICAL APPLICATION OF THE TELEPHONE.—By M. Lindner.—Whoever has to do with telegraphic connections knows that, notwithstanding the most careful arrangements, disturbances often occur which are manifested by a rapid falling off in the action of the batteries employed. The causes of these by-contacts are often so hidden as not to be easily discovered. The case may be mentioned where this phenomenon is due to damp walls and single damp stones, and makes itself perceptible in spite of the wires being carefully infolded. This kind of connection cannot be detected with the ordinary galvanometers, and the well-known and certainly sensitive "testing experiment" throws no light upon the cause. In all such cases the telephone may be usefully applied by simply introducing it into the circuit, and alternately making and breaking contact. We hear then, even with the feeblest currents, a gentle ticking, which in stronger currents becomes a loud cracking, and can then seek for its cause. The author in all such cases makes use, with great advantage, of a sensitive telephone, which has the further advantage that it is much more portable than a delicate galvanometer.—*Zeitschrift für Angewandte Electricität.*

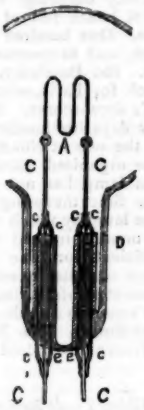
MR. STEPHEN D. FIELD, of New York, has recently patented a device (patent No. 244,218, dated June 8th, 1881) for getting rid of the effect of the static discharge on long duplex lines without the aid of condensers. In this arrangement, which is shown by the



figure, the receiving instrument is short-circuited and the bridge-wire (in which said receiving instrument is located) is broken for an instant both on the opening and closing of the home-transmitter, thus preventing false signals on the receiver.

STORAGE OF ELECTRICITY.—The Cleveland, Ohio, *Trade Review* says that Mr. Charles Brush, well known in connection with electric lighting, has invented what is at present probably the best system of storage yet devised. It adds:—"All as yet known is that metal is used as the recipient by Mr. Brush of the electricity to be stored. It is an important part of the invention that the electricity can be stored for any length of time, awaiting the occasion for use. Mr. Brush recently stated that he was able to store double as much electricity as Faure in a given space."

THE electric lamp shown by the figure has been patented in the United States (patent No. 244,277, dated December 8th, 1880) by Mr. Hiram Maxim, and it consists of a continuous incadescent conductor inclosed in a transparent vacuum-globe in combination



with conducting wires leading to said conductor, each of which is divided where it passes into the globe into two or more branches, to which the material of the globe is directly sealed by fusion.

WESTERN UNION AND AMERICAN UNION TELEGRAPH CONSOLIDATION AND THE CABLE COMPANIES.—Judge Blatchford, of the United States Circuit Court, sitting in New York City, denied the motion made on behalf of the French cable company for an injunction restraining the telegraph consolidation and the closing of the offices of the American Union Telegraph Company, with which the cable company had contracts, that, as it alleged, the consolidating companies could not carry out. He also said, "If hereafter damage is shown to result to the French Cable Company from the sending by the Western Union Company of unconsigned messages over some cable other than a cable of the plaintiff or of said other two cable companies, it may be proper to ask the interference of a court of equity. In such case the question of the existing mutuality of the said agreement will come up for consideration with the questions whether said agreements belong to a class of which specific performance will be decreed, and what control the Court could have over the plaintiff to compel it to observe the agreements on its part."—*Journal of the Telegraph.*

THE EDISON ELECTRIC LIGHT.—The New York *Evening Post* gives the following account of what Edison is doing: "The Edison Electric Light Company has almost finished its work in its first district—that bounded by Nassau Street and the East River, Spruce and Wall Streets—having already wired five hundred houses, and the number of men at work in the district has been reduced from eighty to forty. The eight hundred houses in the district will require about thirty thousand lamps. The mains are laid in most of the streets, and all that is needed to begin lighting by this system are the engines, which are promised by the middle of September. Mr. Edison expects that the first illumination by electricity upon a large scale will take place about the middle of October. The contract

made between the company and householder is that the new light shall cost no more than gas. As it is expected to be in every way superior to gas, there has been no hesitation in accepting the offer. For the last two months Mr. Edison has been busily at work upon what he is going to show at the Paris Exhibition of Electricity. Every outgoing French steamship carries a number of boxes full of machinery from Edison's workshops. One hundred and thirty-seven boxes left last week, and to-morrow's boat will take one hundred more. Mr. Batchelor, with eight assistants, has already left for Paris, where he will remain in charge of Edison's show-rooms. Mr. E. H. Johnson will leave in a few days for London, where a model station, similar to the one at No. 165, Fifth Avenue, in this city, will be organised according to Edison's plans. The Edison lamp has not yet been properly exhibited in London. Since the spring, a change had been made in the Edison lamp by which the lamps last an average of seven months instead of four, and one horse-power is sufficient for nine instead of seven lamps. The change consists in reducing the size of the carbon thread about one-fifth. Improved machinery has enabled Edison's men to do this without impairing the perfection of the thread. The Menlo Park factory is now turning out from nine hundred to eleven hundred lamps a day.

THE Cleveland, Ohio, *Trade Review* states that "the Brush Electric Company's Works, occupying six acres of ground in Mason Street, Cleveland, at the crossing of the Cleveland and Pittsburg Railroad, are the largest electric works in the world. The buildings first erected, and which consisted of a main machine shop 265 by 122 feet, with proportionate large boiler room, blacksmith shop, japanning oven, carbon factory, tool, carpenter and tin shops, have since had important additions. The machinery used is of the most perfected description. The engine driving it is 400-horse-power. In the boiler room are three enormous boilers of Otis steel. They were built by the Variety Iron Works and the Cleveland Steam Boiler Works. The carbon department proves one of the most interesting to visitors. Here are furnaces in operation for the burning of the carbons. Provision is made for 36 furnaces, each of a capacity of 10,000 carbons, capable of turning out 75,000 carbons per day. The plant for the grinding, mixing, moulding, pressing, plating and packing is on a corresponding scale. Three powerful hydraulic presses are in use. Such is the pressure of orders that a new machine shop 410 by 100 feet and an iron foundry 265 by 100 feet is to be added. Some of the material is now on the ground. The buildings are to be of brick, and one storey in height, thus securing the highest amount of solidity and entire freedom from vibration. With the completion of the buildings they will be capable of affording accommodation for 1,500 men, and of turning out from 8,000,000 dols. to 10,000,000 dols. worth of work per annum. On a separate piece of land, facing the works, a laboratory has been erected, in which Mr. Brush will pursue his investigations. Mr. George W. Stockly is the business manager of the company, and Mr. N. S. Possons the superintendent."

THE deaths from lightning in Italy during the years 1864 to 1879 average 119 annually. The highest number was 237 in the year 1868—a year which, in England, was singularly free from thunderstorms—and the lowest was 54, in the year 1866.—*Zeitschrift für angewandte Electricität.*

TELEPHONIC REPORTING.—It is well known that at the *Times* office the telephone has become of great use in reporting directly between the Houses of Parliament and Printing House Square. The proprietors of the *Oldham Express* have followed this example, and have, through Messrs. Moseley and Son, had their offices placed in communication with the offices of Messrs. Dodds and Story, shorthand writers and reporters, of Manchester. The wire is twelve miles in length, and runs close to many other post office wires, and speaking is said to be carried on as easily, as audibly, and as fluently as if addressing a person in the same room. Mr. W. F. Bottomley was the engineer.

TELEPHONE CIRCUIT.—Professor Alexander Graham Bell has patented in the United States (No. 244, 426, June 4, 1881) a cable composed of a number of strands,

each consisting of insulated wires arranged as shown in the figure, the wires of each strand being equidistant, or practically equidistant, from the wires of other strands.

TELEGRAPH STAMPS.—Mr. Fawcett, M.P., writing to a Welsh correspondent, remarks that the question of abolishing telegraph stamps has been for some time under his consideration, but he has not been able yet to come to a decision.

THE INTERNATIONAL MEDICAL CONGRESS.—On Tuesday, the 9th instant, many of the members started from Charing Cross Pier, in a large paddle-wheel steamer specially provided for the purpose by Messrs. Siemens Brothers and Co. The object was an inspection of the famous telegraph cable ship *Faraday*, and the equally famous Woolwich works. The visitors had an opportunity, therefore, of seeing how the telegraphic cable is made, shipped, coiled away, and paid out of the ship named after Mr. Siemen's old friend, Faraday. About 300 gentlemen took luncheon in the works.

ELECTRIC LIGHTING AT RAILWAY STATIONS.—Our contemporary, *Engineering*, quotes the following *data* from the current number of the *Bulletin du Ministère des Travaux Publics*, on the lighting by electricity of large railway stations in Germany and France. The Eastern railway station at Berlin, a large hall 616 ft. long and 114 ft. wide, has been lighted since September, 1879, by 14 lamps, placed 23 ft. above the platforms, and supplied by a 10-horse engine. The installation was made by Messrs. Siemens, of Berlin, who supply the light at a charge of 9 fr. 22 c. per hour, or ·658 fr. per hour per lamp. The Anhalt station at Berlin, 820 ft. long, 205 ft. wide, and 95 ft. high, is lighted by 20 lamps suspended at a height of 21 ft. 3 in. above the platforms. The cost of first establishment, not including motive power, was £1,350. At Düsseldorf the large vestibule of the station, and one platform 492 ft. long, is lighted by electricity, the cost per hour and per lamp being ·311 fr. The new station at Munich, not yet completed, will be lighted by 45 lamps, divided into 9 circuits and worked by 4 gas engines. In France electric lighting has been employed at the Northern station since 1875, and at the Lyons station since 1877. The nightwork done at the Chapelle station is very important, and in winter often amounts to 15 or 16 hours per day. It was to obtain a better light and increase the work done which fell at night to one-half

of that done in the day that the Northern Company decided in 1875 to try the electric light. The installation consisted of 5 Gramme magneto-electric machines, requiring 2·5 horse-power, and costing £60 each. As arranged at a height 18 ft. or 20 ft. each lamp lights an area of 200 ft. radius sufficiently for all the requirements of work. Each of the lamps when working for ten hours costs ·556 fr. per hour. If interest and a sinking fund be added, the price rises to ·80 francs, that is to say, to the standard price of gas. The Paris, Lyons, and Mediterranean company, after having a series of satisfactory trials, which lasted for 45 days in 1877, adopted the Lontin system to light the goods sheds of their fast traffic. The installation, costing £1,880, comprises 18 lamps, the cost of which, including all charges over a service of 4,000 hours a year, is ·295 fr. per hour per lamp, or including interest at 10 per cent., ·346 fr., which is about the cost of ten gas jets. The waiting-room of the Saint-Lazare station is also lighted at a cost of ·65 fr. per hour.

M. FAURE in the English patent for his secondary battery, makes the following claims:—1st. The improved secondary batteries, enabling a large quantity of electro-chemical force or energy to be stored up in a small space and small weight, substantially as hereinbefore described. 2nd. The process of obtaining plates or supports capable of retaining and preserving electro-chemical force or energy by covering them with a layer of porous or spongy metallic matter deposited to any desired thickness by galvanising chemically precipitating, or mechanical adhesion, substantially as hereinbefore described. 3rd. The employment of linings of india-rubber, felt, and other suitable materials for maintaining and holding up to or against the supporting plates the coating or layer of metallic substance mixed or not with inert matter, substantially as hereinbefore described. 4th. The combination with a wheeled carriage, or other vehicle, or boat, or barge, of an electro-dynamic machine carried on the said carriage or vehicle, and a secondary or polarisation battery capable of being recharged at the end of a journey, substantially as hereinbefore described.

FAURE'S SECONDARY ELEMENT.—This apparatus, says *Zeitschrift für angewandte Electricität*, is now judged less favourably. The question is raised whether it might not be more advantageous to convey the electricity through conductors instead of, so to speak, drawing it into bottles. There are circumstances which permit a comparison. We have, *e.g.*, portable gas as well as gas mains. The former system is much used in German railways, and does good service, but it will never supersede the distribution of gas in towns by means of piping. This comparison, indeed, is not quite perfect, for in Faure's accumulators electricity is conveyed in the form of potential energy, whilst in conductors it takes the form of actual energy. But both systems can be combined by fitting up large Faure accumulators at a central station, which can be constantly filled, and thus the production of electricity by dynamo-electric machines can be made independent of the time of its consumption. Whether this plan will be practicable and useful the future must show. The following *data* can be given as to the performance of Faure's accumulator. According to the experiments of Geraldy and Hospitalier, a Planté element can store up 3,450 kilogrammetres per kilo. of lead. Reynier, with 8 Faure elements, succeeded in keeping a platinum wire of 4 metres in length and 0·0012 metre in thickness at a red heat for 100 minutes. From this experiment, Reynier concludes that the storage capacity of the element is 3,750 kilogrammetres. This experiment is ill suited to prove the alleged enormous superiority of the Faure element over the Planté. But we must remember that the Faure element is quite new and may admit of improvement, whilst that of Planté has had a career of 20 years.

THE advisability of lighting the streets of Dundee by the electric light was considered at a recent meeting of the Police Commissioners. The opinion of the meeting seemed to be that the results of the experiments being made in some of the larger towns should be awaited before steps were taken for the introduction of the light into Dundee.

THE Dundee Gas Commissioners have also appointed a Committee to consider and report on the electric light. It was stated at their recent meeting that several large consumers in the town were fitting up their premises for the electric light, and that if it were found satisfactory its development would affect the gas revenue.

THE Portobello Town Council has decided that, in view of the progress being made in the use of the electric light, it would be unwise at present to adopt the Burgh Gas Supply (Scotland) Act, 1876.

So successful has been the trial of the electric light in Greenock that its permanent adoption for lighting the quays, docks and harbours may be taken as settled.

ANTECEDENTS OF THE BELL TELEPHONE. — Mr. G. M. Hopkins concludes a lengthy illustrated article on this subject in the *Scientific American*, in which he refers to the recent decision of the U.S. Circuit Court at Boston, as to the Bell Telephone patent, thus "From what has been said it will be seen that the system of telephonic communication as used to-day is more Reis's than Bell's."

ELECTRIC LIGHT AT THE GREAT NORTHERN RAILWAY STATION, KING'S CROSS.—We received an invitation to view the lighting of this station on Thursday night last, but regret we were unable on that occasion to attend. The success which follows Mr. Crompton's installations of electric light is so well known that the omission of a personal visit becomes of less consequence in this case than usual, but we hope in our next issue to refer again to the subject, and to deal then more fully with detail than we can at present give space to do. The motive power is obtained off a short length of counter-shafting by a semi-portable engine by Messrs. Marshall & Co., of Gainsborough, the nominal horse-power being 12, but the engine is capable of working up to 35 horse-power. A second engine, for safety, will soon be added of the same type as that now used. Burgin machines in two groups, one of 2 machines, and one of 3 machines, are the generators, the field-magnets of each group being excited by two small dynamo-machines. The exciting current is said to be about 12 webers, and the effective current through the inside lamps about 17 webers, and that through the outside lamps about 24 webers. The lamps inside the station are 12 in number, 6 above the arrival platform and 6 above the departure platform, whilst outside the station the lighting is effected by the two more powerful lamps placed on a separate circuit. Thus there are 14 lamps, 3 on each of four separate circuits, and 2 lamps (outside) on a single circuit. When all the lights are in full work it is found that about 29 horse-power indicated is required, of which the engine and gearing absorb about 3½ horse-power each, of the exterior lamps about 3 horse-power and each of the interior lamps about 1½ horse-power. The engine shed is lit up by Swan lamps, requiring about 1½ horse-

power. An Addyman's clutch, manufactured by Messrs. Bagshaw, of Batley, will be used to put either engine into gear with the shafting instantaneously, in case of accidents.

ELECTRIC LIGHT AT EARNOCK COLLIERY.—Mr. John Watson, the proprietor of the above colliery, having determined on lighting it by electricity, a trial with the Swan incandescent lamp was made on the afternoon of the 9th instant. Since April last, Messrs. D. and E. Graham, of Glasgow, have been engaged fitting up the said lamps, which are somewhat modified in form to adapt them for safe use in mines. The Swan lamp, which is well known to our readers, is inclosed in an outer lantern consisting of a strong glass globe, air-tight and protected with steel guards. Each lamp was also connected with two different forms of Graham's patent safety air-tight contacts and switches for cutting off and letting on the current, the effect of which, it is believed, would be to render the lamps quite safe, even in the presence of explosive gas. The motive power used is a steam-engine, also used for driving a saw-bench, the dynamo-machine an A Gramme, situated at a distance of 260 yards from the pit-head. The conductors used are as follows:—*Dynamo to pit-head:* bare copper rope ⅜ in. diameter carried on poles and very effectually insulated at supports by a combination of porcelain cups and vulcanised india-rubber.—*Down shaft:* cable of 19 No. 22 B. W. G. copper wire insulated with gutta-percha taped and tarred, and inclosed in a galvanised iron ½ in. tube.—*Underground:* same conductor as down shaft, carried along workings partly on wooden uprights and partly beneath surface.—*Lamp leads:* No. 14, 16, 18 or 22 copper wire according to length.—*Number of lamps* at present working: 16 fixed and 6 portable, spread over about two miles (reckoning the return circuit) of wire.—*The fixed lamps* are suspended from roofs of workings, and are inclosed, as before-mentioned, in strong glass globes, and fitted with convex reflectors of silvered copper, whilst the *portable lamps* are attached to long flexible cables for use at the facings, and can be hung or deposited in any position. They are inclosed in very strong glass lanterns which are again protected by the stout wire guards. Although there is at present little or no gas in Earnock Colliery, all lamps, switches and contact-makers are constructed as for a fiery mine, being made quite air-tight, so as to render impossible the communication of a spark to the atmosphere of the mine. On the day of opening, blasting with gunpowder took place without affecting the lamps in the slightest degree. Messrs. Graham and their engineer, Mr. Alfred R. Bennett, M.S.T.E. and E., are to be congratulated on their success, as also is Mr. Watson on his spirited policy in inaugurating the new and improved illumination in his underground property. It may be mentioned that after an inspection of the light by the latter gentleman and some invited guests, Mr. Annan, of Glasgow, took photographs in three groups of the whole party assembled by the sole aid of the light afforded. On the return of the party to the surface an adjournment was made to the workshops. Mr. A. Jamieson, principal of the College of Science and Arts, Glasgow, who represented Mr. Swan on the occasion, gave to his practical audience a description of the construction and application of the Swan lamp. In connection with this an interesting incident transpired. Mr. Jamieson in answer to a colliery manager admitted that if the incandescent lamp as shown were broken in an explosive gas, an explosion would assuredly follow. An experiment was immediately arranged to determine the truth of this. An explosive mixture was prepared, and on the glass of the lamp being broken the explosion of course took place precisely as predicted.

New Patents—1881.

3254. "Improvements in cables or conductors for telegraphic, telephonic or similar purposes, which invention comprises an improved method of and apparatus for covering or coating wire with insulating material." H. H. LAKE. (Communicated by David Brooks.) Dated July 26.

3283. "Electric generators." S. PITT. (Communicated by S. J. M. Bear.) Dated July 26.

3274. "Improvements in lamp casings or holders for containing and protecting electric lights and in apparatus to be used in connection therewith, the said apparatus being in part applicable for other purposes." D. GRAHAM. Dated July 26.

3293. "Improvements in apparatus for igniting gas for illuminating by means of electricity, and in batteries connected therewith." A. J. HALLAM and J. WALSH. Dated July 27.

3294. "An electrical musical instrument called a 'Pianista.'" W. F. SCHMOELE and A. MOLS. Dated July 27.

3305. "Electric lights." Sir C. T. BRIGHT. Dated July 28.

3346. "Improvements in electrical signalling apparatus and in circuit connections adapted to fire alarms, messenger calls and telephones." J. U. MACKENZIE. Dated August 2.

3349. "Electric lamps." A. W. REDDIE. (Communicated by D. A. Chertemps.) Dated August 2.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1880.

5008. "Electro-magnetic induction machines." H. WILDE. Dated Dec. 1. 2d. Relates to a method of constructing electro-magnetic induction machines with multiple armatures for producing electricity, by which their power and efficiency are greatly increased. In this improvement the metal wheels or discs in which the armatures are mounted are slit in a radial direction towards the centre of each iron armature. The armatures are also slit in a radial direction towards their centres, and are fixed in the wheels in such a position that the slits in the wheels and the slits in the armatures coincide or extend into each other. The ends of the electro-magnets are terminated by pole pieces of iron, while the iron armatures which revolve between them are without such pole pieces. The polar terminations of the magnets are of such a diameter as to overlap the armatures, so that the magnetic circuit is never broken. The pole pieces at the ends of the magnets are slit radially towards the centres of the magnet cores. The sides of the discs in which the armatures are mounted are perforated near their centres for the purpose of admitting a free circulation of air between the coils of the armatures. (*Void by reason of the Patentee having neglected to file a Specification in pursuance of the conditions of the Letters Patent.*)

5268. "Transmitting drawings, characters, and writing by electricity," &c. A. W. L. REDDIE. (A communication from abroad by Jacques André, of Paris). Dated Dec. 15. 6d. This invention relates to an improved system of electro-autographic transmission.

The main feature of the invention consists of a band of mixed tissue or web of any convenient length or breadth, formed by the grouping of a variable number of metallic conducting wires or threads, which are insulated electrically the one from the other by means of a weft of textile material, the warp threads being formed by the metallic conducting wires themselves. The reproduction of a tracing is effected by making this web pass under one end of a brush connected to a battery at the transmitting station at the same time that a receiving surface formed of slips of paper, or of a continuous band of paper or woven stuff, is caused to pass under the correspondingly formed brush at the receiving station. The receiving paper or fabric is covered with some substance which is decomposed or chemically changed by the electric current, so that by the action of electricity the original design will be exactly reproduced.

5387. "Micro-transmitters." WILLIAM JOHNSON. Dated Dec. 22. 6d. Relates to improvements in micro-transmitters, and it consists in a novel arrangement of the well-known principle of the microphone of Professor Hughes, and also in a combination of such novel arrangement of a resistance coil or coils, shunt or shunts, all of which are embraced in an electric circuit, the object of the improvements being to render articulate speech and other similar sounds loud, clear, and distinct in the receiving telephone, which is attached to the line wire in the usual way. In carrying out the invention a microphone, consisting of two carbon pencils, is suitably supported on a diaphragm of wood, horn, mica, or other suitable material, and between the ends of the carbon pencils bobbins of insulated wire are connected in such a manner as to cause them to resist the passage of an electrical impulse, or to act as a means of shunting such an electrical impulse. The

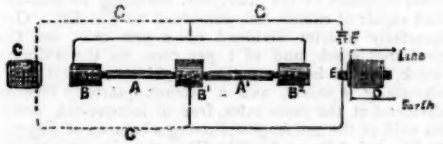


figure represents a micro-transmitter of the improved construction. A and A¹ are pencils of carbon loosely supported in blocks of the same material, B, B¹, and B²; these blocks are secured to a diaphragm by preference of pinewood, and which is fastened to a suitable sounding-box. C is a shunt or branch circuit of proper resistance; D is an induction coil, the secondary coil of which is placed in the line circuit in the usual way. The positive current from the battery, F, passes through the primary, E, of the induction coil, D, to the central block, B¹; it then either divides between the arms or takes the arm or pencil which offers the least resistance, being either A or A¹, and completes the circuit through the connection, G. If contact is momentarily interrupted in the arm, A, the arm, A¹, allows the circuit to be completed, and *vice versa*, and thus the possibility of a breakage in the primary circuit is to a great extent obviated; but in order to render the manifestation in the receiving telephone of such a breakage impossible, the branch circuit, C, is introduced, so that if breakage or other disturbance should occur in the microphone by which the circuit cannot be completed through the microphone, the circuit is then made through the shunt, C, which is of low resistance, thus effectually bridging over the fault and allowing the induced extra current to pass without the injury to the contact points, and thus speech is much more faithfully reproduced and with increased clearness and distinctness of articulation, whilst the common harsh and grating noise so often heard is prevented.

5482. "Telephonic apparatus." C. J. WOLLASTON. Dated Dec. 30. 6d. Has for its object so combining telephones, microphones, or other form of transmitter, electric batteries, switches, and signal bells, as to make the entire apparatus portable and convenient for use in military and naval operations, the exploration of coal pits and mines, in torpedo or submarine mining, and for other purposes where the telephones are used out of doors or exposed in such a manner as to render them liable to be affected as to their practical efficiency by local disturbing influences.

City Notes.

Old Broad Street, August 11th, 1881.

GLOBE TELEGRAPH AND TRUST COMPANY. — The eighth ordinary meeting of this company was held on July 29th at Cannon Street Hotel, Mr. John Pender, M.P., being in the chair. The net revenue for the year was £171,379, of which sum £122,066 had been distributed in interim dividends. A final distribution of 3s. per share was declared on both Preference and Ordinary shares, making a dividend of 6 per cent. on the Preference and 4½ per cent. on the Ordinary shares The Chairman, in proposing the adoption of the report, stated that, notwithstanding a reduction from 5 per cent., paid in 1880, to 3½ per cent. paid this year by the Anglo-American, they were able to pay the usual rate of dividend by the profits upon exchanges with the Brazilian, Eastern, Eastern Extension, and other companies. They had acquired 3,000 Eastern shares in exchange for 1,000 Telegraph Construction and Maintenance shares. An improvement of ½ to ¾ had taken place in Easterns since the acquisition. The number of shareholders on the register had increased from 600 to 6,000, and the increase had been most considerable during recent years. Of the 66,000 miles of cable which had been laid, the company held shares in companies owning 47,563 miles, or more than two-thirds of the whole. In reference to the American cable, he did not anticipate any injury to the interests of the company. He was only astonished that the Americans had not before this had a cable of their own. He showed that the charge of being a monopoly had no foundation. If the directors had acted in the spirit of monopoly they might have paid much larger dividends, but they had preferred to make reductions in favour of the public. Sir Daniel Gooch seconded the motion, which, after some discussion, was carried without a dissentient.

THE SUBMARINE TELEGRAPH COMPANY.—The half-yearly ordinary general meeting of the proprietors of this company was held August 3rd at the City Terminus Hotel, under the presidency of Sir James Carmichael, Bart., the chairman of the company. The directors' report to the 30th June, 1881, showed a net balance of £38,077, which enabled them to add 10 per cent. to the gross receipts to the reserve fund, and to recommend a dividend at the rate of 19 per cent. per annum. The Chairman, in moving the adoption of the report and statement of accounts, alluded to the new offices in Throgmorton Avenue, and said that the total cost of the new building would be something like £200 a year less than they were paying before to the Post Office, besides which the company had acquired a valuable and improving property, which he considered as a valuable investment for their reserve fund. Under their present charter they had not power to purchase land or property to the amount of more than £1,000, and as their present building exceeded that sum, they were con-

sequently beyond the powers of their charter. They had already asked the shareholders for a supplemental charter to fix the additional outlay, but the solicitor advised them that the legal expenses would be considerable, and suggested that they should register the company under the Limited Stock Companies Act, 1862, under which Act they would have power to purchase land or property to any amount. The board had, he said, endeavoured to prepare a scheme for providing a fund for the benefit of the staff of the company in accordance with the recently expressed wishes of the proprietors, but they found some difficulty in dealing with this question, as the plan of endowment assurance generally adopted by other telegraph companies did not appear altogether applicable to the position of a large number of the company's servants. The board had been advised that under clause 87 of the deed of settlement of this company, they had full power to make such compensation as they might think fit to any of the clerks, agents, and servants of the company, without any special resolution of the proprietors. The board had resolved to treat every individual case which might come before them with great care and liberality. They had laid down about eight miles of new cable, and thus the cost of repairs to cables in the past six months hed been larger than usual. The motion for the adoption of the report was seconded by the Hon. Ashley Ponsonby, and, after a brief discussion, unanimously agreed to. On the motion of the Chairman, seconded by Sir Thomas Dakin, the following resolution was also carried:—"That in lieu of applying for a supplemental charter, as authorised by the resolution passed at the half-yearly meeting of the proprietors, held in February, 1879, the directors be authorised to register the company under the Companies Acts 1862 to 1880, as a company limited by shares, for the purpose of giving the company further powers to purchase or take on lease land to erect suitable premises for carrying on the business of the company." The usual routine business was run through, and the dividend having been declared, the usual compliment to the Chairman and staff terminated the meeting.

MEDITERRANEAN EXTENSION TELEGRAPH COMPANY, LIMITED.—The forty-eighth ordinary half-yearly general meeting of the shareholders of this company was held on August 5th, at the Cannon Street Hotel, Sir James Carmichael, Bart., the Chairman of the company, presiding. The directors' report of the past six months ending the 30th June last showed that there had been an increase in the traffic of the previous half-year of £631, and the amount to be claimed under the guarantee of Her Majesty's Government would be proportionately diminished. The directors proposed payment of the usual dividend at the rate of 8 per cent. per annum, less income-tax, on the preference stock of the company, and at the rate of 3 per cent. per annum on its ordinary stock, leaving £462 to be carried to the reserve fund. The Chairman in moving the adoption of the report and statement of accounts, suggested that it would be better to leave the question of the purchase of the property by another company until after the report had been agreed to. Turning briefly to the accounts, he said they would see that the amount to the credit and reserve fund stood at £11,401; amounts owing on account of messages transmitted over other lines to 30th June last, £10,311; sundry amounts owing by the company, £132; balance of revenue account, less income-tax, £3,510. On the other side of the account there was funded property (amount invested in New Three Per Cents.), £11,394; amount due from other lines on account of messages transmitted by this company to the 30th June last, £8,499; sundry amounts due to the company, £125; cash in hand, £521; cash at bankers, £130; short bills in hand, £1,859; amount due from Her Majesty's Government, £2,826. He remarked upon the condition of the company's affairs, and said the company's cables were in good order, and the cost of maintenance had been trifling. He then formally moved the adoption of the report, which was seconded by the Hon. Ashley Ponsonby, and without discussion, agreed to. The Chairman then referred to the question of the purchase by another telegraph company of the property and interest of this company. After explaining the terms under which it was proposed that this should be effected, he said that before deciding upon anything definite, the board would of course summon the shareholders together and lay the whole matter before them. On the motion of Dr. Dearle, seconded by Mr. Hibbert, it was decided to leave the question entirely in the hands of the directors, they in the meantime to put themselves in communication with the Treasury and endeavour to negotiate satisfactory terms. This was, after a good deal of discussion, agreed to. The Chairman having declared the dividends on the ordinary and preference stock of the company, the retiring directors and auditors were then duly re-elected, and the usual compliments to the Chairman and board terminated the meeting.

ANGLO-AMERICAN TELEGRAPH COMPANY, LIMITED.—The half-yearly general meeting of this company was held on August 5th at the City Terminus Hotel, under the presidency of Viscount Monck. The report stated that the total receipts from the 1st of January to the 30th June last, including a balance of £66, brought over from the last account, amounted to £300,431. The traffic receipts showed an increase as compared wit the corresponding period of last year of £31,455. The total expenses of the half-year, including income-tax and repair of cables, &c., amounted to £61,885. One quarterly interim dividend of 2 per cent. on the preferred stock, and of 1 per cent. on the ordinary stock, free of income-tax, was paid on the 1st May, absorbing £70,000, and a second quarterly interim dividend at the same rates, free of income-tax, would be paid on the 2nd August, leaving a balance of £23,545 to be carried forward. The Chairman, in moving the adoption of the report, remarked that the state of things which he had to bring before them, if not particularly exhilarating, did not, in his opinion, afford any reason for despondency. The commercial depression, of which they had heard so much for years past, though considerably relieved, had not entirely passed away. He then referred to the circumstances which led to the postponement of the payment of the dividend on the last occasion, and reminded them that it had since been paid. Their cables were in good working order, and carrying the traffic as well as could be expected. He afterwards alluded to the visit of their solicitor (Mr. Birt) to New York, to watch over the company's interests in the difficulties mentioned in the report, consequent on the combination of the land telegraph companies in the United States; and referring to the charge of monopoly which was made against the Atlantic Telegraph Companies, his lordship spoke of the reductions which had been made in their tariffs, and the excellent manner in which their work was done. The reductions had put more money into the pocket of the company, and they must only hope that the reduction to 1s. a word would have the same effect, and that notwithstanding the competition of the new cable, there would be room for them all. Sir James Anderson seconded the motion, and it was unanimously adopted.

THE WEST COAST OF AMERICA TELEGRAPH COMPANY, LIMITED.—The report of the directors presented to the shareholders for the year ending December 31st, 1880, shows the gross revenue to be £17,398 4s. 2d., and the expenditure £31,815 1s. 6d., leaving a balance of £14,416 17s. 4d. to the debit of revenue account. The revenue account though far from satisfactory, is as favourable as could reasonably be looked for under all the circumstances. The expenses of the repairing steamer *Retriever* are rather large, but the next accounts will show a considerable saving in these expenses, whilst the trading earnings of the steamer will, it is expected, show a material increase. At the time of issuing the last report, three sections of the company's cables were cut and out of use, and it is only since the cessation of the war that all the sections have been repaired and the entire system put into complete and perfect working order. All the company's cables are now in active operation, and ready to take advantage of any increase of business that may be brought about by the revival of trade, and the re-establishment of peace on the Coast. Since the 1st of May, 1881, the receipts of the company have shown a steady increase, and have amounted, for the three half-months ending 15th instant to £5,000. It will be satisfactory to the shareholders to learn that during the repairing operations the manager had many opportunities of inspecting the general condition of the cables, and that he reports they are in as good a condition as when they left the works of the manufacturers.

DIRECT UNITED STATES CABLE COMPANY, LIMITED.—The eighth ordinary general meeting of this company was held on July 28th, at the City Terminus Hotel, under the presidency of Mr. Pender, M.P. The Chairman, in moving the adoption of the report, and the declaration of a final dividend of 5s. per share, making, with interim dividends, a total dividend of 5 per cent. for the year, stated that the revenue for the half-year to the 30th of June last, after deducting out payments, amounted to £93,581, and the working and other expenses, including interest on debentures and income tax, absorbed £26,871, leaving a balance of £66,710 as the net profit of the half-year. They had carried £32,292 to the reserve fund, and they carried forward £7,179. The expenses had been maintained at their present figure, in spite of a very large increase in their business. He congratulated them on this fact, on the repairs having cost only £2,496 which had been charged to the reserve fund, and on the increase of that fund to £235,000. He denied that the submarine telegraph system had been a monoply, and alluded to constant reductions having been made in the tariff. This company and the Anglo-American Company were now about to reduce the charges to 1s. a word, a matter which he said had been long under consideration of both boards. As to the effect of the Americans having a submarine telegraph system of their own, he believed, seeing the enormous growth of the business, that there would be room for all of them. The resolution was seconded and carried unanimously.

THE CONSOLIDATED TELEPHONE CONSTRUCTION COMPANY.—The statutory general meeting of the above company was held on the afternoon of the 8th instant at the City Terminus Hotel. Sir Julius Vogel, K.C.M.G., the Chairman, presided, and stated that as the present was the statutory meeting of the company, there was no business to transact; but it had occurred to the directors that he might take that opportunity making a general statement as to the position and of prospects of the company. They had over 700 shareholders. They had already established a factory, and in course of a week or two they would be able to turn out between 100 and 200 instruments a week. They had an agreement with the United Telephone Company, by which that company had bound themselves to take all the instruments they required from this company; and he reminded them that that company, after a great deal of litigation, had practically secured a monopoly of the telephone in the United Kingdom. Outside that arrangement, this company had to fulfil orders for a very large number of instruments which they took over when they purchased the rights of Mr. Gower. This company had also the sole right of making and selling telephones for export in this country, and they anticipated a very large export business. They had acquired valuable patents for abroad. In his opinion the telephone in this country and in Europe, and indeed everywhere except in the United States, was in the very earliest infancy of its development. Altogether he though they had excellent prospects before them in this country, apart from the special rights to which he had referred. A vote of thanks to the Chairman terminated the proceedings.

THE UNITED TELEPHONE COMPANY.—At the first annual meeting, held on August 9th, at the Cannon Street Hotel, Mr. James Brand in the chair, the report and accounts having been taken as read, the Chairman, in moving their adoption, said he thought the shareholders would agree with him that the balance-sheet was, on the whole, not unsatisfactory. He was glad to say that they met under more pleasant circumstances than they did when he last addressed them. At that time they were surrounded by dangers on every side. The directors were accused of every imaginable fault, and people predicted the utter collapse of the undertaking; but now there was manifest vigour, and, considering the difficulties with which they had had to contend, and how greatly they had been hampered by the uncertainty as to their position in relation to the Government, he thought the development attained was very remarkable. All this time the directors had been plodding on, preparing the cables and other things which were necessary to enable them to meet the increased requirements of the public, which were now, he was happy to say, pouring in upon them. He had before him some remarkable statistics compiled by the auditors, showing the gradual increase in the number of subscribers, and in the use of the instruments, and the decreased expense at which the results were achieved. In the months of May, June, and July, 1880, the company having begun with only forty subscribers, the average number of calls was 2·2 per day, while the total number of subscribers for the three months was 609. In August, September, and October, the average number of calls was 3·1, and the number of subscribers rose to 707. In November, December, and January, there were 415 calls and 820 subscribers. In July of this year there were six calls on the average per day. There were now 1,052 subscribers, and there were many orders on hand. To this he might add that the expenditure had fallen from its highest point of £350 to £201 per week. These figures spoke for themselves, and were a complete answer to those who had regarded them as enthusiasts amusing themselves with a toy. Some of the hotels, and a great many of the principal tradesmen, were now availing themselves of the services of the company, and what was most needed was for the shareholders to assist in the development of their own property. Of 650 shareholders, so far as the London district was concerned, only 25 were at present subscribers. The company would receive £50,000 for the sale of half their interest in the district of the Lancashire and Cheshire Telephone Company, keeping the other half, which he

considered to be worth £50,000 more. In concluding, he remarked that they were working in a friendly spirit with the Consolidated Construction Company.—Mr. J. S. Forbes having seconded the motion, a discussion ensued, in the course of which Mr. Galsworthy expressed his satisfaction that solicitors would be allowed to charge telephone messages sent by them professionally as if they were letters. Ultimately the report, including the recommendation of a payment of 10s. per share as bonus out of the £50,000 to be received from the Lancashire and Cheshire Telephone Company, was adopted. A resolution was afterwards agreed to approving an agreement with Mr. C. H. Reed, for granting an exclusive licence for the use of the company's patents in certain districts to a company intended to be formed under the name of "The Northern District Telephone Company," the proceedings terminating with a vote of thanks to the chairman.

A POSTAL TELEGRAPH COMPANY (of America) which promises to be a rival of the Western Union, says a correspondent of the *Daily News*, has been organised. Mr. James R. Keene is the president. Among the stockholders are the Californian Bonanza millionaires. The company have acquired several novel patents, including W. A. Leggo's automatic machines, said to send two thousand words a minute; the Leggo facsimile machine, which sends autographic telegrams (those shown are like photographs); the Gray harmonic multiple system, which is claimed to surpass even the quadruplex. The Way duplex system has also been acquired. Peculiar interest attaches to this invention, owing to its alleged applicability to cables. Relays are not used even on land. The capital of the company is twenty-one million dollars. The subscriptions announced amount to ten millions. They have already spent on plant and patents over two millions. It is estimated that the total cost and equipment sufficient for any amount of business will not exceed fifteen millions.

MR. JAMES A. SCRYMSER, president of the Central and South American Telegraph Company, is said to have arrived in this country to close a contract for some three thousand miles of telegraph cable, to be laid along the Pacific coast of Central and South America from Mexico to Peru, connecting at Vera Cruz with the Mexican Telegraph Company's lines, and at Callao with the West Coast Telegraph to Valparaiso and the Argentine Republic.—*Railway News.*

GLOBE TELEGRAPH AND TRUST COMPANY.—Mr. W. Griffiths, barrister-at-law, has been elected auditor to this company in place of Mr. Newmarch, who has retired.

THE Eastern Telegraph Company notifies the restoration of telegraphic cable communication with India, China, Manilla, Java, Australia, and New Zealand, *via* Bombay.

THE board of the Oriental Telephone Company, Limited, have received the following message from Alexandria, Egypt, dated 9th inst.:—"Telephone Exchange opened yesterday. Subscribers now talking. Working satisfactorily."

The following are the final quotations of stocks and shares:—Anglo-American, Limited, 51½-52; Ditto, Preferred, 82½-83½; Ditto, Deferred, 24¾-25¼; Brazilian Submarine, Limited, 10⅝-10⅞; Brush Light, ——; Electric Light, ½-⅝; Consolidated Telephone Construction, 1-1¼ A; Cuba, Limited, 9½-10; Cuba, Limited, 10 per cent. Preference, 16½-17; Direct Spanish, Limited, 4¾-5¼; Direct Spanish, 10 per cent. Preference, 13½-14½; Direct United States Cable, Limited, 1877, 10¾-11½; Debentures, 1884, 102-104; Eastern Limited, 10⅜-10⅝; Eastern 6 per cent. Preference, 12⅞-13⅛; Eastern, 6 per cent. Debentures, repayable October, 1883, 102-104; Eastern 5 per cent. Debentures, repayable August, 1887, 102-105; Eastern, 5 per cent., repayable Aug., 1899, 105-108; Eastern Extension, Australasian and China, Limited, 11-11¼; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 107-110; 5 per cent. Australian Gov. Subsidy Deb. Scrip, 1900, 103-106; Ditto, registered, repayable 1900, 103-106; Ditto, 5 per cent. Debenture, 1890, 103-105; Eastern and South African, Limited, 5 per cent. Mortgage Debentures, redeemable 1900, 103-106; Ditto, ditto, to bearer, 103-106; German Union Telegraph and Trust, 10⅛-10⅜; Globe Telegraph and Trust, Limited, 6½-6⅝; Globe, 6 per cent. Preference, 12¾-13; Great Northern, 13-13½; 5 per cent. Debentures, 103-106; India Rubber Company, 23-24; Ditto, 6 per cent. Debenture, 104-108; Indo-European, Limited, 28-29; London Platino-Brazilian, Limited, 5⅛-6⅛; Mediterranean Extension, Limited, 2¾-3¼; Mediterranean Extension, 8 per cent. Preference, 9¼-9⅝; Oriental Telephone, ¼——; Reuter's Limited, 12-13; Submarine, 290-300; Submarine Scrip, 2¾-3; Submarine Cables Trust, 100-104; United Telephone, 9⅛-9⅜; West Coast of America, Limited, 4⅞-5⅛; West India and Panama, Limited, 1¾-2; Ditto, 6 per cent. First Preference, 7-7½; Ditto, ditto, Second Preference, 6-6¼; Western and Brazilian, Limited, 8-8¼; Ditto, 6 per cent. Debentures "A," 110-115; Ditto, ditto, ditto, "B," 101-105; Western Union of U. S. 7 per cent., 1 Mortgage (Building) Bonds, 125-130; Ditto, 6 per cent. Sterling Bonds, 106-110; Telegraph Construction and Maintenance, Limited, 29-29½; Ditto, 6 per cent. Bonds, 104-108, Ditto, Second Bonus Trust Certificates, 3¼-4¼.

TRAFFIC RECEIPTS.

NAME OF COMPANY.		JUNE.	JULY.	REMARKS.
		£	£	
Anglo-American...	1881	48,240	46,410	After July the publication of the receipts of this company will be suspended.
	1880	*19,560*	*19,500*	
Brazilian S'marine	1881	12,272	11,755	Calendar month
	1880	*10,624*	*10,900*	
Cie. Française ...	1881	...	...	Not published.
	1880	..	..	
Cuba Submarine...	1881	2,757	2,300	
	1880	*3,147*	*2,915*	
Direct Spanish ...	1881	1,456	1,448	
	1880	*1,277*	*1,423*	
Direct U. States...	1881	16,080	15,470	
	1880	*6,580*	*6,500*	
Eastern	1881	40,074	38,171	
	1886	*42,522*	*43,352*	
Eastern Extension	1881	29,339	31,751	
	1880	*29,100*	*32,104*	
Great Northern ...	1881	21,760	22,400	
	1880	*22,520*	*23,500*	
Indo-European ...	1881	...	...	Not published.
	1880	..	..	
Submarine	1881	...	...	Publication temporarily suspended.
	1880	..	..	
W. Coast America	1881	...	...	
	1880	..	..	
West. & Brazilian	1881	3,943	9,396	Five weeks in each case.
	1880	*3,728*	*8,611*	
West India	1881	4,743	4,116	
	1880	*3,907*	*3,712*	